NYASALAND PROTECTORATE

Annual Report

of the

Department of Agriculture

1927

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Staff List

Director	...	E. J. WORTLEY, O.B.E., F.C.S., F.L.S.
Assistant Director	...	E. W. DAVY.
Agricultural Chemist	...	A. J. W. HORNBY, B.SC., A.I.C.
Entomologist	...	C. SMEE, M.C., D.I.C., F.E.S.
District Agricultural Officer		F. BARKER, C.D.A. (Edin).
District Agricultural Officer		N. D. CLEGG.

Empire Cotton Growing Corporation.—Staff List

Cotton Specialist	...	H. C. DUCKER, B.SC., N.D.A.
Asst. Cotton Specialist	...	J. V. LOCHRIE, A.I.C.T.A., B.SC., N.D.A., N.D.D.
Asst. Cotton Specialist	...	E. LAWRENCE, N.D.A.
Farm Manager	...	W. L. MILLER.

Report of the Department of Agriculture for the year 1927.

EUROPEAN AGRICULTURE.

In Annexure V are the agricultural statistics for 1927 which have been compiled from the returns forwarded by European planters. The acreages of the various crops under cultivation in 1927, as compared with the previous year and with a decade ago, are shown below :—

	1917 acres	1926 acres	1927 acres
Coffee	1,237	1,323	1,239
Cotton	28,372	13,358	2,545
Fibres	988	6,212	6,282
Rubber	5,580	1,365	1,320
Tea	4,523	5,788	7,070
Tobacco	9,516	22,908	25,002
Miscellaneous	3,882	16,211	17,465
Total ...	54,098	67,165	60,923

The outstanding change that has taken place in the past ten years is the reduction in the cultivation of cotton and the expansion in the acreage planted with tobacco, while there has been a marked increase in the acreages under tea and sisal.

According to the returns of the Comptroller of Customs, the agricultural exports, inclusive of both European and Native grown produce, in 1917, 1926, and 1927 were valued as follows :—

	1917 £	1926 £	1927 £
Coffee	70	2,174	1,203
Cotton	39,947	93,243	45,834
Fibres	5,194	16,799	24,428
Rubber	5,344	10,364	13,049
Tea	5,176	62,675	56,640
Tobacco	67,665	457,122	780,964
Miscellaneous	4,381	2,551	3,223
Total ...	£127,777	£644,928	£925,341

Unfortunately the total value of the exports for 1927, which is the highest on record for the Protectorate, must be discounted by the fact that much of the bright tobacco shipped to brokers at home still remains unsold owing to the dull condition of the market for this class of tobacco.

Tobacco.—When the tobacco buying season opened in 1927, the prospects appeared to be excellent; the acreage, European and Native, was the highest on record; yields above the average were being obtained; and unusually high prices were being paid. Towards the middle of the buying season, the first shock of what has since proved to be a serious situation was felt; buyers curtailed their purchases of brights and at the same time reduced their prices. This action on the part of local buyers proved to be an accurate forecast of the coming stagnation of the home market for brights. The market for darks remained firm.

In recent years Nyasaland has grown to be more and more dependent on tobacco as its major export industry as shown by the following figures :—

Year	Tobacco Acreage under cultivation: European acres	*Native acres	Total acres	Total value of agricultural exports £	Value of tobacco exports £	Percentage value of tobacco exports %
1918 ...	6,027	8,330	14,357	489,680	279,511	57
1919 ...	9,817	1,485	11,302	389,371	271,396	70
1920 ...	14,218	1,748	15,966	612,360	481,519	79
1921 ...	21,074	1,400	22,474	377,442	297,091	79
1922 ...	18,554	1,276	19,830	424,570	316,540	75
1923 ...	17,308	2,973	20,281	407,516	257,998	63
1924 ...	20,590¾	3,312	23,902¾	560,799	352,348	63
1925 ...	22,415	11,026	33,441	539,095	345,872	64
1926 ...	22,908	16,107	39,015	644,928	457,122	71
1927 ...	25,002	18,601	43,603	925,341	780,964	84

* Estimated

It is clear that a serious depression in the market for tobacco must be viewed with much concern by a country as dependent as Nyasaland is on its tobacco crop. Fluctuations in market values of any crop must be expected from time to time, but critical examination of the tobacco situation at present indicates that the production in Empire tobacco growing countries has outstripped the existing demand of manufacturers for certain classes of tobacco.

In considering the future, it is important that Nyasaland should endeavour to develop alternative export crops, and this subject is dealt with later, but it is even more important at present, especially in view of transport limitations, that the keenest efforts should be made to consolidate and strengthen our position as a tobacco producing country.

Success in maintaining our position in spite of increasing competition depends upon three requisites :

(1) Careful study of market requirements as to grades and quantities.

(2) The quality of the tobacco exported.

(3) Reduction of the cost of production.

Unfortunately, the difficulty of obtaining, before the planting season, reliable guidance with regard to the demand that may be expected for different classes and grades of tobacco is one of the most perplexing problems of the planters.

Market reports indicate satisfaction in general with the tobacco shipped from this country, and planters, compelled by economic conditions, are giving the most careful attention to the question of costs. This is all to the good, but successful tobacco production is one of the most intricate and exacting branches of agriculture, and planters should make the closest study of the report (Annexure I) of Capt. A. J. W. Hornby, Agricultural Chemist, and of the bulletins that he has from time to time prepared for their guidance.

Cotton.—Ten years ago Europeans had under cultivation over 28,000 acres of cotton; in 1927, less than one tenth of this acreage was planted.

The decline of cotton to a point at which it ceases to be of serious importance in the list of crops grown by Europeans for export is particularly regrettable in view of the urgent need for alternative crops to tobacco.

Apart from the question of insect attack and concomitant low yields, the European is severely handicapped in planting large acreages of cotton on an individual estate owing to the difficulty of securing an adequate labour force at planting time (when it is most important that advantage should be taken of favourable spells of rainfall), as well as by the scarcity of labour at harvesting time in areas where Natives grow cotton on their own. But there is no reason why cotton should not be grown more extensively in rotation with tobacco at mid-elevations in the Protectorate. The success of the variety Over-The-Top imported by the Empire Cotton Growing Corporation has led to considerable interest being shown by planters in cotton for rotation purposes, and small plots are now being tried on a number of estates where cotton was not grown before or where its cultivation had been abandoned.

Tea.—There has been a steady increase in the acreage planted to tea and the area under this crop amounted to 7,070 acres in 1927. The prospects of the industry continue to be promising, and improved methods of cultivation and manufacture have with good results followed the profitable prices obtained in recent years.

Although the general vigour of the tea bushes in Mlanje has always been favourably commented on by visitors from other tea growing countries, it has been recognized locally that various forms of root disease needed investigation. The Mlanje planters approached Government some time ago on this subject and it was fortunately found possible for arrangements to be made for Dr. E. J. Butler, F.R.S., Director of the Bureau of Imperial Mycology, to visit Nyasaland for the purpose of studying the tea diseases of the country. Dr. Butler arrived in February, 1927, and spent most of the time at his disposal in Mlanje where he made a comprehensive investigation of the tea diseases present. Before his departure, Dr. Butler addressed well attended meetings in Mlanje and Cholo, describing the diseases he had identified and outlining practical measures for their control. Much stress was laid on the importance of preventing erosion and maintaining soil fertility.

Prior to the arrival of Dr. Butler, Captain C. Smee, Government Entomologist, made a preliminary survey of the tea diseases in Mlanje, in such time as could be spared from his normal duties, and during Dr. Butler's visit he kept in close touch with his investigations. Captain Smee has since been responsible for advising the tea planters on plant sanitation and disease control.

Fertilizers have not been used to any extent on tea in this country in the past, but a start is now being made and the attention of tea planters is drawn to the recommendations of the Agricultural Chemist on this subject (Annexure I). The value of leguminous plants for building up soil fertility is well known and of the many crops tested in Nyasaland for this purpose, the most promising is a bush lima imported by the Department and multiplied at the experimental stations of the Empire Cotton Growing Corporation. Seed stocks are now available for distribution.

Coffee.—There has been a slight reduction in the acreage planted with coffee in 1927 as compared with 1926, the figures for the two years being, respectively, 1,239 and 1,323 acres.

Yields per acre have been disappointing. As pointed out in previous reports the distribution of rain in this country is not favourable for coffee cultivation. The crop can, however, be dovetailed conveniently with tobacco from the standpoint of labour requirements, and, for this reason, there are advantages in planting small acreages on tobacco estates. But, apart from the risks of too low a rainfall at critical periods, pests and diseases have to be combated, and it will only result in loss if planters embark on coffee cultivation, unless they are prepared is give the most vigilant attention to the necessary control measures. Guidance on these matters will be found in the report of the Government Entomologist, (Annexure II) and in departmental publications prepared by him.

One of the most valuable methods of mitigating the effects of the inadequate rainfall in the winter months and at the flowering period is the building up of the humus content of the soil by means of cattle manure, if available, and by the planting and digging under of legumes.

Coffee growers who can divert water for the purposes of irrigation, should certainly adopt this means of compensating for the dry spell from May to November.

Sisal.—In 1927, there were 6,282 acres under sisal as compared with 6,212 acres in 1926, and 988 acres in 1917. This crop is one of the least dependent on a regular rainfall and has the added advantage that it is comparatively free of pests and diseases.

The small field sisal decorticator, that was recently put on the market, promises not only to cheapen the cost of production on established plantations, but also to enable those who cannot find the capital for planting operations on a large scale to take up the cultivation of sisal on a comparatively small acreage.

Rubber.—The growth of rubber is restricted to the Vizara Estates near the lake shore in the West Nyasa district. Production in 1927 amounted to 179,088 lbs. as compared with 171,623 lbs. in 1926.

NATIVE AGRICULTURE.

Tobacco and cotton continue to be the export crops that find favour with Natives, a marked preference being shown for tobacco in areas where the two are optional. The proportion of the country's total production of these crops for which Natives have been responsible is given below for 1927 compared with previous years:—

	Percentage Produced by Natives	
	Tobacco	Cotton
1917	4	29
1924	14	35
1925	33	63
1926	41	74
1927	43	83

Tobacco.—The rapid expansion of the native tobacco industry in recent years was maintained in 1927 and the production amounted to 3,484 tons as compared with 2,023 in 1926; the crop figures for 1924-1927 are given below:—

	Tons
1924	525
1925	1,177
1926	2,023
1927	3,484

Returns of purchases rendered by buyers in accordance with terms of the Tobacco Ordinance are as follows:—

	Tons
Mlanje	364
Cholo	353
Blantyre	345
Chiradzulu	562
Zomba	193
Upper Shire	14
South Nyasa	22
Ncheu	187
Dedza	86
Lilongwe	860
Dowa	384
Kota-Kota	66
Fort Manning	48
	3,484

The number of Natives who registered as tobacco growers for the 1927 season is shown below according to administrative districts:—

Mlanje	7,071
Chclo	1,716
Blantyre	2,048
Chiradzulu	9,470
Zomba	8,333
Upper Shire	1,067
South Nyasa	473
Ncheu	2,864
Dedza	3,287
Lilongwe	13,291
Fort Manning	2,850
Dowa	10,303
Kasungu	1,119
Kota-Kota	2,424
	66,321

In 1927, the production of fillers was somewhat in excess of the requirements of local buyers and Natives experienced considerable difficulty in disposing of their poorer grades. Appreciably lower prices prevailed than in the previous year.

The duty of seeing that the policy of the Native Tobacco Board is carried out, especially in as far as it relates to the work of the District Agricultural Supervisors, falls largely on the Director of Agriculture as chairman of the Board.

In 1926 and in the first half of 1927, the Board had two Agricultural Supervisors. In August, 1927, three additional Supervisors were appointed. The work of the Board has been concentrated in the Central Province and four of the five Supervisors were stationed in that province.

Each Supervisor has been responsible, with the assistance of fifteen native instructors for a section with about 4,000 registered growers; this area he toured once a month, giving practical advice to the growers and checking the work of the native instructors, to each of whom a specific number of villages was assigned. At the end of the month the native instructors assembled at the headquarters of the Supervisors, handed in their reports, and received orders regarding their work for the next month. The Senior Supervisor in the Central Province, in addition to having a section of his own, had general responsibility for the work of the three other Supervisors.

In this manner an intensive district service is being developed that is exerting a real and beneficial influence on the quality of the tobacco produced by native growers.

Cotton.—There was a distinct decrease in the output of native-grown cotton, the production being 1,387 tons of seed cotton in 1927 as compared with 2,197 tons in 1926. The total production of cotton by Natives for the years 1920-1927 is shown below, together with the district returns for 1926 and 1927.

	SEED COTTON (TONS)
1920	315
1921	375
1922	392
1623	747
1924	1,369
1925	2,909
1926	2,197
1927	1,387

DISTRICT PRODUCTION 1926 AND 1927

	1926	1927
Lower Shire	1,266	779
Chikwawa	571	352
Central Shire	165	147
Mlanje	89	25
Blantyre	25	24
Ncheu	34	16
Liwonde (Upper Shire)	3	11
South Nyasa	12	4
Dedza	20	21
Dowa	12	8
Total	2,197	1,387

The falling off in 1927 can be attributed in a large measure to disappointment with the prices paid in the previous year. Mental satisfaction at the reward that he receives for his trouble, rather than economic pressure, would appear to govern the native in his decision to grow export crops. Prices paid by the British Cotton Growing Association were 1¼-1½d for No. 1, 1d. for No. 2, and ¼-½d. for No. 3. A total sum of £19,748 was distributed among native growers.

The Empire Cotton Growing Corporation has now produced sufficient seed of "Over-The-Top" to allow of a serious start being made with the task of replacing "Nyasaland Upland" in areas in which "Over-The-Top" has proved to be superior. One ton of seed of this variety was sent to Lisungwe, as this section was considered, owing to its isolation and to the interest taken by Chief Simon in cotton growing, to be the most suitable for multiplication on a commercial scale of a new variety.

Food Crops.—During the year under review the production of native food crops was on the whole satisfactory. There was no serious shortage of food in villages, but the surplus available for sale in the more settled areas was not sufficient to meet the requirements of European employees of labour, and it is to be regretted that 600 tons of maize had to be purchased outside the Protectorate.

A considerable amount of attention has been paid by district officers of the Department and the Native Tobacco Board to the important question of native food crops. Propaganda has mainly been on the lines of encouraging the planting of adequate sized gardens and of impressing upon Natives the necessity for proper care of their gardens.

Observations and experiments show clearly that the low yields of maize and mapira (sorghum) obtained by many Natives are in a large measure due to indifferent methods of cultivation, such as inadequate preparation of land, too wide spacing, and neglect of weeding at critical periods. Mapira selected from native gardens has averaged 1,750 lbs. per acre for the past three years at Makwapala, but yields from native gardens are disappointingly low as a rule. Similarly, experiments conducted in Mlanje and on the Lower River showed that improved methods of cultivation greatly increased the yield of the strains of maize in the possession of Natives.

Combined with a higher standard of cultivation, the improvement of local strains and the introduction of new varieties is capable of greatly increasing the yield per acre common in native food gardens, and during the year selected strains of maize and mapira have been issued to Natives; this work is being largely extended. New introductions that are being experimentally tested and that give promise of proving of value are groundnuts from Gambia, cassava and yams from the Malay States, mapira from Portuguese East Africa, rice from Tanganyika, and soya beans from America.

No crop has the advantages of cassava for growth in areas subject to drought, but native conservatism and tribal preferences for certain classes of diet prove serious obstacles in the way of inducing Natives to make more general use of this crop.

DIFFICULTIES IN THE WAY OF EXTENDING THE RANGE OF CROPS FOR EXPORT.

A tendency to depend largely on a single crop is not confined to Nyasaland. Other instances that come to mind are coffee in Brazil, sugar in Cuba, and bananas in Jamaica, and there are many cases of large agricultural areas that specialize almost exclusively in one branch of farming. This practice, in spite of the recognized risks, is the not unnatural outcome of a combination of economic factors. The policy, however, has two serious disadvantages. When market conditions for the crop, on which dependence is placed, are unfavourable, there is the danger of the effect being felt by all sections of the community, and no system of agriculture that ignores the benefits of rotation, where "annuals" are grown, can be considered to be really sound.

The present stagnation of the market for bright tobacco and the danger of Empire production of other classes of tobacco exceeding the demand, owing to the interest now being evinced in this crop, make it most desirable that all possible methods of widening the basis of production of this country should be examined.

The task of recommending rotation crops *per se* is not difficult, but that of pointing to alternative crops to tobacco that can, under existing conditions, be grown for export at a reasonable profit is beset with many difficulties. Four formidable obstacles stand in the way of success in a search for new crops. They are: (1) the long dry spell in the winter months; (2) the absence of irrigation to mitigate the effects of the dry season; (3) inadequate railway facilities for the transport of low priced products; and (4) the limited local market for the minor, but, in the aggregate, important products of mixed farming.

In considering the question of new crops, the issue is not merely that of finding economic plants that will grow in the Protectorate. It is essential that they can be cultivated and exported at a profit in competition with the same products from other countries that are well suited for various reasons (such as soil, temperature, rainfall, and transport facilities) for their growth on a commercial scale.

Critical examination of the possibilities of certain crops, as alternative to tobacco, bring us up against the difficulties to which reference has just been made. For example:—

(1) The long dry spell mitigates against the profitable cultivation of such crops as coffee, cocoa, and rubber.
(2) The absence of irrigation systems has a restricting effect on the possibilities of sugar and rice at lower elevations.
(3) Lack of railway facilities and high freight rates prevent the export of maize and groundnuts on a commercial basis.
(4) The small European population and the absence of manufacturing or mining centres deprive our farmers of a local market of any magnitude for fruit, maize, wheat, cattle, dairy products, poultry, etc.

A certain measure of success in reducing the country's dependence on tobacco may be expected from an increased growth of cotton, especially as a rotation crop, from extended planting of tea and sisal in suitable areas, and from a cautious expansion of the areas under coffee. Full advantage should be taken of the local market, limited though it be, for such produce as flour, bacon, cheese, jams, etc.

A venture that appears to be well worthy of consideration is the formation of co-operative butter and cheese factories in selected areas. It is, also, desirable that the possibilities of nuts and fruits should be examined by a specialist who has had experience with these crops in those portions of South Africa where climatic conditions approximate most closely to those in Nyasaland, and definite proposals for such an investigation have been made to Government.

Adoption of the above suggestions would tend to place the agriculture of the country on a sounder basis, but the fundamental need, if the range of export crops is to be extended, is improvement of the present railway facilities.

Tobacco Investigations by the Agricultural Chemist.

In his report for the year (Annexure I) the Agricultural Chemist outlines the results of the field work supervised by him at the Zomba and Matiti experimental plots and of his laboratory investigations. The report also contains an interesting review of the tobacco industry in which much practical advice is given regarding the lines on which the industry can best be developed.

In the absence of a tobacco specialist on the staff of the Department, the Agricultural Chemist has for some time past undertaken the advisory and other duties that would pertain to such an officer, and Government has now recognized his services in this connection by granting him a special duty allowance.

Report of the Government Entomologist.

During the year under review the Government Entomologist, whose report (Annexure II) is attached, paid particular attention to investigation of the root gallworm in tobacco seedbeds and to the study of pests and diseases of tea. A bulletin recording in detail the results of the experimental trial of various chemicals for the control of root gallworm has since been published, and a bulletin on the tea mosquito bug and other tea pests will be issued later.

Captain Smee's work in connection with tea diseases has been of special value in assisting tea growers to give effect to the recommendations made by Dr. Butler.

On the subject of coffee pests, the Entomologist draws attention to the serious situation that will eventually be created by those planters who put in a few acres of coffee and pay little or no attention to the destruction of coffee borers. By such neglect breeding centres are being established that will prove a menace to those who are seriously interested in coffee growing.

Empire Cotton Growing Corporation.

I have again to record our indebtedness to Mr. H. C. Ducker, Cotton Specialist, and the other members of the staff of the Empire Cotton Growing Corporation for their work in this country. Striking success can now be reported with the cotton variety "Over-The-Top," which was imported by the Corporation in 1924. Selected strains of this variety have been acclimatised at Makwapala and Port Herald and have been tested during the year under review in various districts. "Foster Whitehall," a variety also imported in 1924, promises well on the Lower River, but has proved unsuited to higher elevations.

Increased attention has been paid by the Corporation to the experimental work at their station near Port Herald, as a large proportion of the cotton exported from the Protectorate is now grown at lower elevations.

The Cotton Specialist keeps in close touch with the activities of the Corporation in South Africa and Southern Rhodesia, and all promising strains of cotton developed in those countries are supplied to him for trial in Nyasaland.

In the course of their cotton investigations, the officers of the Corporation have done much experimental work with rotation crops, and the yields per acre of certain crops, grown for rotation purposes at Makwapala, are given below as the figures are of interest in connection with the possibility of extending the list of crops grown in this country for export.

Crop	Yield per acre		
	1925	1926	1927
	lbs.	lbs.	lbs.
Grains			
Maize	1,878	3,008	2,418
Maweri	2,150	2,078	1,846
Machewerl	2,431	—	1,200
Mapira	2,253	1,398	1,000
,, (Sumbwi)	2,862	606	—
,, (Kapile)	2,538	—	—
,, (Namuzi)	1,623	—	—
Legumes			
Velvet Bean	1,455	—	—
Bush Velvet Bean	—	—	1,125
Nandolo	—	—	634
Nkhungudzu	—	—	302
Lima Beans	202	125	—
Tepary Beans	473	—	—
Oil Seeds			
Sesamum	390	—	—
Sunflower	1,360	—	—
Groundnuts—unshelled (Spanish bunch)	940	1,370	1,410
,, ,, (Local) ...	1,600	1,302	1,060
Fibres			
Sunn Hemp (Fibre)	1,000*	1,000*	—
,, ,, (Seed)	940*	—	600
Jute Fibre (olitorius)	—	500*	—
,, ,, (capsularis)	—	500*	—

* Estimated

District Agriculture Work.

A general idea of the district work on behalf of the Natives was given in the section of this report dealing with native agriculture. The reports of the District Agricultural Officers, Mr. F. Barker and Mr. N. D. Clegg, are attached (Annexures III and IV).

Publications Issued in 1927.

Agronomic Series.

Circular No. 1.—Notes on Tobacco varieties in Nyasaland: Relative to climatic conditions, soil and fertilizers. A. J. W. Hornby, B.Sc., A.I.C., Agricultural Chemist.

Circular No. 2.—White Burley and air-cured tobaccos. A. J. W. Hornby, B.Sc., A.I.C., Agricultural Chemist.

Bulletin No. 2.—Types of Nyasaland-Grown Tobacco. A. J. W. Hornby, B.Sc., A.I.C., Agricultural Chemist.

Leaflet No. 4.—Prices of artificial manures, June, 1927. A. J. W. Hornby, B.Sc., A.I.C., Agricultural Chemist.

Entomological Series.

Bulletin No. 1.—First Report on Pests and Diseases of Tea in Nyasaland. Colin Smee, D.I.C., F.E.S., Entomologist.

Bulletin No. 2.—First Report on Pests and Diseases of Coffee in Nyasaland. Colin Smee, D.I.C., F.E.S., Entomologist.

Officers on Leave.

During the year Mr. E. W. Davy, Assistant Director, was on leave from 1st January to 10th July and Mr. F. Barker, District Agricultural Officer, from 1st January to 20th February.

Conclusion.

Definite progress in the work of the Department during the year can be reported and it is with pleasure that I have to acknowledge the keen interest taken by the officers of the Department in their duties. The Assistant Director in addition to carrying out the normal duties attached to his post has been making a study of the flora of the country; the Agricultural Chemist and the Government Entomologist, although working without much needed assistants, have undertaken the responsibility for branches of work outside their own subjects; district work has been materially strengthened by the employment by the Native Tobacco Board of a staff of European and native instructors; and the investigations of the Empire Cotton Growing Corporation have now reached a stage at which they are proving of material benefit to the cotton industry. Much, however, remains to be done to cope with the varied agricultural problems of the country, and I hope that the time is not far distant when it will be possible to place the plant introduction and the plant breeding work of the Department on a sounder footing.

E. J. Wortley, Director of Agriculture.

Annexures.

I—Report of Agricultural Chemist.
II—Report of Government Entomologist.
III—Report of District Agricultural Officer, Fort Johnston.
IV—Report of District Agricultural Officer, Chiromo.
V—Agricultural Statistics for the year 1927.

Report of Agricultural Chemist.

GENERAL FIELD WORK.

In the absence of the Assistant Director on leave, I carried on the field work on the 30 acres of land recently acquired for a seed and experimental station near the Department. I have carried out the duties of Tobacco Inspector from April 1st. Some variety trials and tests with dark tobacco were made and continued in the present season. Rotations were started comparing two year rotations with continuous tobacco plots and three year rotations with continuous tobacco plots, the tobacco being fertilized. It was also possible to commence experiments on the renovation of worn-out land, combining rotations with manuring. Artificial farmyard manure was made by fermenting dried native grass, including Napier fodder, with and without cotton seed meal by the agency of "*Adco.*" Cotton seed was used in varying quantities as manure on such land.

The expenditure was in part financed by the Native Tobacco Board, who also made a contribution to the Matiti seed and experimental station which is being run by the Blantyre and East Africa, Limited, under my supervision.

The opening and laying off of these virgin lands occupied much of my time during the latter half of the year. Too much is not expected in this—the first year—but the usefulness of these two stations, dealing with different types of tobacco, will increase as data is collected from year to year, and it is desirable that an assistant officer should be appointed for closer supervision of the experimental work.

Extension and survey work, which necessitated travelling of over 6,000 miles during the year, still take up much of my time. Most districts and a large number of planters were visited from Karonga to Mlanje.

REPORT ON WORK AT EXPERIMENTAL STATION.

Results of Field Trials.

Variety trials: *Tobacco.*—Amongst new tobacco varieties tried were Flanagan, Green Briar White Burley, Maryland Mammoth and Green's Wildfire Resistant Orinoco. As far as possible seed of the varieties tried are obtained from experimental stations in the U.S.A. as it is likely that the plants will be more true to type than those grown from seed obtained from general seedsmen.

Thanks are due to the Directors of many of these stations for supplying carefully selected seed.

Western (acclimatized) easily gave the largest yield with 835 lbs. per acre. Other varieties gave yields as follows:—

	Marketable leaf lbs. per acre.
Wildfire Resistant Orinoco	540
Melton	685
Green Briar Burley	640

The latter were grown from unacclimatized seed and received similar treatment on newly opened land.

Legumes.—Amongst green manures, especially for tea, we have tried Sunn hemp, Bunch Velvet Beans, and numerous varieties of Soya beans. O-too-tan and Biloxi easily lead the way amongst the latter as the following table shows:—

Variety of Soya Bean	Yield of seed per acre lbs.	Time in reaching maturity Nyasaland	America
O-too-tan	1,010	106	—
Biloxi	825	109	160
Tokio	591	101	—
Goshen Prolific	310	99	145
Tarheel	237	78	140
Hayto	226	92	135
Laredo	99	114	145
Chiquita	177	111	135

O-too-tan leads in yield of seed and in growth, and should prove useful as a green manure crop at higher and upper middle elevations, either alone or interplanted with other crops. It shows promise amongst tea in Mlanje.

Biloxi shows distinct promise as a green manure, and yields a fair crop of palatable beans which should be useful as a subsidiary food crop.

As regard the shattering of Soya beans in the field, this is not considered a disadvantage if harvesting is done at the correct time. (See Journ. Amer. Soc. Agron. Vol. 17, p. 157.) When it is considered that the feeding value of one pound of Soya bean flour is equal to two pounds of meat and a quarter pound wheat flour, the growing of this crop should become more popular at higher elevations. A yield of 600 lbs. becomes of increasing moment. (See "China: Land of Famine." Amer. Geog. Soc. No. 6 Spec. Pub.)

Other leguminous plants which may be of use for green manuring tea and coffee land are as follows, with remarks as to comparative growth. More attention must be paid to inoculation:—

Bunch velvet beans (*Stizolobium deeringianum*): good in every respect.
Bush lima beans (*Phaseolus lunatus*): * good growth, especially late.
Fish bean "Ntutu" (*Tephrosia vogelii*): * fair only.
Tephrosia candida: fair; useful as wind-break.
Sunn hemp (*Crotolaria juncea*): * very good.
Crotolaria striata: * good.
Cajanus indicus ("Nandolo"): * fair, good on poor soils.
Cassia hirsuta: poor at higher elevations.
Indigofera spp. (*arrecta* and *endecaphylla*): growth fair; suitable in mixed manuring.
Tifton Bur clover (*Medicago hispida*): fair; late growth at higher elevations.
Lucerne (*M. sativa*): fair; late growth often under poor conditions defoliated by leaf disease. †

Ground-nuts (*Arachis hypogoea*) fair at all elevations on sandy loams.
Mung bean (*Phaseolus mungo*) "Mpoza": attacked badly at lower elevation by leaf-eating insects.

Japan clover (*Lespedeza*): fair; needs further trial.
Vigna oligosperma: poor at higher elevations.

Amongst other legumes tried may be mentioned sainfoin, crimson clover, trefoils, vetches, subterranean clover, bokhara clover which seem never to have shown any promise in Nyasaland. Sesbania species have shown no promise. Lupines grow very well for a short period but proved to be very susceptible to disease and nematode attack. Climbing varieties of cowpeas (*Vigna sinensis*) and velvet beans have been as usual very successful for certain rotations. Late planted mung bean or green gram suffered from white rust or field mildew.

Ammonia Trials.

		Yield per acre.			
		Melton 1926/27		Big Burley 1927/28	
		Green Weights	Dry Weights	Green Weights	Dry Weights
1.	Diammonium Phosphate	2130	430	5880	782
2.	No fertilizer	971	180	5500	526
3.	Ammonium Sulphate	2080	490	6840	762
4.	No fertilizer	811	170	3400	595
5.	Urea	1820	450	4800	665
6.	No fertilizer	1030	220	3980	492
7.	Nitrate of Potash and Ammon. Sulphate	2720	608	6840	530
8.	Ammonium Sulphate	2380	540	5880	1035
9.	No fertilizer	750	180	3980	725
10.	Nitrate of Potash and Urea	1810	440	5200	795
11.	No fertilizer	690	190	2720	427
12.	Blood Meal compound fertilizer	1060	260	5160	795
13.	No fertilizer	330	80	2920	765
14.	Ammonium Sulphate	1820	830	5360	741
15.	„ „	1980	520	5760	905

The ammonia plots received 20 lbs. of nitrogen per acre, 48 lbs. of potash and 84 lbs. phosphoric oxide, except the blood meal plot which only received 8.3 lbs. of nitrogen per acre in 1926-27, but the full amount in 1927-28. Magnesia and muriate apparently made no difference on plots 15 and 8 respectively. It will be noted that plots 3, 5, 7, 8, 10, 12 and 14 received lime in double superphosphate and plot No. 15 received lime as precipitated bone phosphate, in which form the phosphoric oxide was supplied.

There is no reason to suppose as a result of these initial trials that the ammonia in urea, sulphate and phosphate of ammonia is of different fertilizing value. Indications are that nitrogen in nitrate form, as in the potash salt, will in certain years give the best results. It seems that about a quarter of the nitrogen supplied to tobacco should be in this form as a side application up to twelve days after planting (Circular No. 3 of 1923).

Further trials comparing precipitated bone phosphate and double superphosphate at Namadidi and Zomba indicated no difference in availability on lateritic and red loams. Other results of experiments were published in bulletins and leaflets during the year.

Note on some poor land on the Experimental Station.—We may here briefly give the properties of a depleted lateritic soil—particularly by loss of active organic matter—on the station at Zomba.

1. Low absorptive capacity. Very low volume expansion of 1.3 per cent. Amount of water taken up by unit weight of soil is 0.33.

2. Quickly cakes on drying, and there is very slow rise of water by capillarity, varying of course with the state of the subsoil or plough-sole.

3. Tobacco wilts at a comparatively high water content for the mechanical composition, e.g., about 12 per cent. for an average.

4. Low content of humus, small number of bacteria, low ammonifying and nitrifying power and small carbon dioxide evolution. Microbiological analyses are often very necessary before an accurate presentment of the condition of Nyasaland soils can be made. The method of Waksman of estimating value of humus offers us a good means.

* Reaches maturity on very low rainfall.
† Identified by the Assistant Director as *Pseudopeziza medicaginis*.

Pot Experiments.—As regards the nitrifying power, there was found after 40 days in large pot experiments a complete nitrification of ammonia sulphate at the rate of 300 lbs. per acre, even on a poor soil of the Zomba station, the amount of nitrate nitrogen being multiplied one and a half times. Where organic matter was dug in, as in the experiment with pigeon pea (*Cajanus indicus*) green manure, in 40 days nitrate nitrogen had increased by $7\frac{1}{2}$ times. The rate of application was two tons per acre of dry material, the amount of nitrogen added being approximately 150 lbs. Liming but slightly increases nitrification in these experiments. (See also Annual Report, 1926.)

The experiments show that even on these poor soils, nitrogen from organic nitrogenous materials is readily nitrified. In the renovation of these worn-out soils by an economical combination of manuring with organic nitrogenous material, fertilizers and green manuring, which was started in 1926, it is already clear that the green manuring crop such as velvet beans and/or sunn hemp required to be supplied with plant food which may be most economically supplied as organic material, such as "*Adco*" fermented straw, cotton-seed meal or germinated cotton seed dug in, at the rate of about 1,000 lbs. per acre, in order that sufficient growth may be obtained for efficient manuring.

Laboratory Work.

Nitrogen content of tobacco plants.—Investigations into the nitrogen contained in the tobacco plant at various stages of growth were undertaken during the year. (See also Annual Report 1926.)

The low percentage of nitrogen in Hickory Pryor of the Bonanza class (see Bulletin No. 2) has been shown as 1.26 to 1.62 in air-dry leaf; Cash leaf contained 1.34 as an average; dark-fired leaf (Western and Melton) contains from 3.92 to 4.36 in well-grown plants (air-dried).

The percentage of starch in well grown dark leaf (oven-dry) was 20.8, and in a poorly-grown plant suffering from "sand-drown" was 14.7 in oven-dry leaf after extracting with petroleum ether, ether, and alcohol.

Production of Alcohol.—Zomba, with the water supply of the Mlungusi and Likangala, is a good place for this purpose. The native *Sorghum vulgare*, "mapira," was tried as a source of malt. The malt proved to have high diastatic powers and the yeasts used in native brewing proved to have strong fermentative powers.

Analyses of Mlungusi water are given below. It seems also that this water is suitable for brewing beer for European consumption.

Parts per	100,000
Free and saline ammonia	.003
Organic ammonia	.010
Chlorine	.15
Nitrous Nitrogen	Nil
Nitric Nitrogen	.005
Alkalinity	.125
Oxygen absorbed	.0135
Total solids	2.6
Phosphates	Very faint trace

Examination of sediment: slight vegetable debris.
Appearance of residue on ignition: very slight charring.
Reaction: slightly alkaline.

Seed Disinfection.—Much tobacco was disinfected during the year. I have now adopted the method of treatment with 1:1,000 silver nitrate. One hundred and fifty pounds were disinfected.

Germination tests of tobacco seed disinfected with 1:1,000 silver nitrate show that the germination powers remain unaffected:—

	Percentage of germination		
	After 5 days	After 2 months	After 10 months
Kentucky Yellow ...	90 ...	92 ...	90
Lizard Tail	75 ...	81 ...	80
Wildfire Resistant Orinoco	60 ...	69 ...	70

Soil analyses and reports were made during the year. Soil containing roots and nodule bacteria of various legumes was supplied to local planters.

In co-operation with other Departments: Veterinary.—Twelve stomach contents were analysed to find whether animals had died of dip poisoning. Usual supply deci. normal iodine supplied to Chief Veterinary Officer.

Preparations sodium hypochlorite were supplied to the Senior Medical Officer. The manufacture of cattle dip was continued in Zomba for all government tanks. This represents a considerable saving over purchase locally.

Short Review of the Tobacco Industry for the Past Seven Years.

The tobacco industry in Nyasaland has progressed very much during the last seven years. In 1913 the total amount exported was 3,763,014 lbs., most of which was flue-cured and two-thirds of which was of pipe grades. In 1921 the total amount produced was 4,000 cwts. by Natives and 60,148 cwts. by Europeans, a total of over seven million pounds. The production has risen in 1927 on the one hand to 69,680 cwts., nearly all dark-fired tobacco grown by Natives, and on the other to 93,647 cwts. of European flue and fire-cured and air-cured tobacco. The total exports in 1927 exceeded fifteen million pounds.

Nyasaland tobacco has become increasingly popular on the U.K. market, and the slump which occurred early in 1927 is regrettable, especially as a large preferential duty still exists for Empire tobacco.

It is interesting, however, to review the industry during the past few years illustrating the changes that have occurred. Numerous types of tobacco are produced from the varying soil and climatic conditions of Nyasaland and some types are the counter-part of American growths. The growth of the latter in the field cannot be distinguished, there is a similar time taken in ripening and the methods of curing are identical. The yield, also, of tobacco per acre grown by the true-bill planter are similar to those produced by Virginians or Kentuckians growing similar types and varieties.

There has been a greatly increased use of fertilizers and manures, the importation having risen from practically nothing in 1920 to about 1,000 tons of highly-concentrated materials in 1927. In some sections, however, the yield has not increased to any great extent, which may be put down to three causes :—(*a*) the incidence of leaf-spot diseases such as black-fire in some seasons, of stem diseases in others, such as Pythium sp. and of root diseases such as nematode galls ; (*b*) entire lack of rotations or manuring programmes ; (*c*) an unsuitable acreage—often too large for the accommodation or on unsuitable land for the type aimed at. These points will be further discussed in the following pages.

Fertilizers and Manures on Tobacco Land.—The fertilizers in most general use in Nyasaland during the past few years have been double superphosphate, sulphate of ammonia and potash derived from the sulphate, muriate and nitrate. The nitrogenous manures have been partially or wholly applied after planting out, and this latter method started in 1921 has been most profitable in the average season. Many planters have shewn great intelligence in these side applications, paying due respect to the time land has been in cultivation, to the period which has elapsed from the commencement of the rains, and to the amount of rainfall which is likely to lead to leaching of plant food. Where muriate is used, I have now recommended that the percentage of chlorine should not exceed 4 per cent. in the complete mixture, so that the good burning quality of Nyasaland tobacco is not impaired. This usually means not more than 25 lbs. of muriate per acre, a further 25 lbs. being derived from the sulphate or nitrate.

As regards sand-drown (magnesia hunger) which occurs on some soils in Nyasaland frequently and on others in certain seasons, there is no direct means of telling whether this will occur on any one soil. The availability of the magnesia bears no relation to the total amount and seems to depend on the amount of available lime and phosphates present. The latter has been put forward by me as a factor in Bulletin No. 2 of 1925. Investigations were continued by the Imperial Institute during 1926 and 1927. The results will be fully reported upon in due course, but may here be summarised :—

(*a*) The amount of magnesia in the soil which is soluble in dilute acid gives little indication of the availability of the magnesia and as to whether sand-drown is likely to occur.

(*b*) Small applications on many soils of muriate of potash are not likely to have any influence in preventing sand-drown in Nyasaland.

(*c*) Where sand-drown is prevalent, 6 lbs. of available magnesia should be applied for every 100 lbs. of artificial fertilizer. This may be supplied by finely-ground dolomitic limestone, or burnt lime containing about 10 per cent. magnesia, applied some months before planting. About 500 lbs. of these limes per acre should be supplied to give the necessary amount of available magnesia, as much will be of a coarse nature and incapable of being dissolved. The magnesia may be also applied as sulphate of potash-magnesia (double manure salts) or sylvinit, which give totally soluble salts of magnesia. (Note : Dolomitic limestones occur at Port Herald and at Lirangwe.)

The general mixture, the constituents of which to the extent of about 200 tons were imported by Zomba planters co-operatively in 1926 for the 1927 season was—

Double Superphosphate	...	...	...	100	pounds.
Sulphate of Ammonia	...	...	...	100	„
Muriate and Sulphate of Potash		...	...	60	„

The greater proportion of the ammonia was applied together with some of the potash salt after planting. The figures refer to the total applications per acre, and it may be said in general that the double superphosphate with the potash salt was applied before planting with 20 per cent. of the sulphate of ammonia ; and 80 per cent. of the sulphate of ammonia with two-thirds of the potash salt were applied after planting.

This may in future be referred to as the general Likangala formula for the average sandy loam of that series. The formula is 16-8-13. The inclusion of a filler reduces such a formula to the equivalent 10-5-8 (see Bulletin No. 1 of 1926). In some cases the pre-planting application was omitted and only a mixture of sulphate of ammonia and a potash salt in the proportions 2 : 1 used as a side application. Also nitrate of potash replaced the muriate, and the formula thus made up with more concentrated material worked out as the equivalent at 19-9.5-11.5. Of course the formula may be altered for sandy soils by increasing the nitrogen or for soils well supplied with organic matter and for many soils in the second year after opening up by decreasing the nitrogen.

Some planters still prefer to apply fertilizers to tobacco land in one composite mixture and to dispense with side applications, but with our greatly fluctuating rainfall, I cannot recommend this. The new concentrated fertilizers such as Diammonium phosphate and Urea now manufactured from atmospheric nitrogen are being imported into Nyasaland. The general plan is to give a pre-planting application of diammonium phosphate followed by an application after planting of nitrate of potash or a mixture of urea. These are used to a larger extent by dark-tobacco growers. I may here thank Messrs. Humphrey Brothers for their help in trials on a large scale of these fertilizers and also in trying out varieties for me which have proved successful.

Note.—A 16-8-13 mixture may be made up with 80 lbs. diammonphos, 87 lbs. filler, 25 lbs. urea and 70 lbs. nitrate of potash. The two latter may be applied after planting according to the principles enumerated in Circular No. 2 (1927).

Determinations of organic matter in soils which have been continuously cropped for several seasons has shown a marked deficiency, especially for the growing of high quality dark tobacco. The influence of this deficiency is seen in the description of poor soils in this report. For this reason, in formulas for soil types there has been included some fertilizers of organic origin such as cotton-seed meal and dried blood, whose availability is seen above. The inclusion of such manures will in future be inseparable from real farming on older land in this country, although on newly-opened land there is often plant food, well balanced and in sufficient amount, for the growth of good quality tobacco.

Rotations.—Rotations for tobacco soils have been discussed in Bulletin No. 1 of 1926, "Tobacco Culture." It is interesting to note that Canadian results support our scheme in which maize immediately precedes tobacco. On many light soils of the Eastern United States, however, maize is not considered of benefit in bright tobacco rotations.

Varieties.—I have discussed many points dealing with agronomic varieties of tobacco in Circular No. 1 of 1927. I introduced in 1925 from American experimental stations seed of carefully selected plants from the varieties Cash and Jamaica Wrapper which have proved successful at lower elevations and especially on soils such as the sandy loams of the Vua, Tuanjati, Michiru and Bwanje Valley series for the production of flue-cured tobacco. The variety Melton, also introduced by me in 1925, has proved successful in the production of dark tobacco, but is not yet proved superior to Blue Pryor or Western. Yellow Mammoth gives good results on many soils.

Varieties such as Lizard Tail Orinoco and Little Dick, which are grown in Virginia for the production of dark-fired tobacco, have not yet been thoroughly tried out but show distinct promise in certain areas. I do not like Kentucky Yellow and similar varieties. With such a wide range of conditions for growth in Nyasaland, it is often difficult to say which is the best variety to grow and the best time to plant. Later plantings of dark varieties at lower elevations are often most successful. A large stock of seed of approved varieties is to be kept at the Zomba station by the Native Tobacco Board. The advantage seems always to be with acclimatized strains. It may be interesting to observe that Western is superior to Melton in one season and is inferior in another, due to different climatic conditions. It is absurd to go upon the experience of one season.

It happens in the course of an industry in tropical agriculture, especially in one-crop countries, that some planters forsake varieties which we may here call standard because it may be difficult to obtain produce of the highest quality under normal conditions. This may be due to the requirements of the variety in plant food or in soil texture; or the susceptibility of the plants to some disease may demand methods of culture which are outside the means or the knowledge of the individual; or, again, the climatic conditions such as rainfall may be far removed from the optimum required for their growth. Other varieties may do fairly well, give high yields and be disease resistant under such circumstances, although the produce is often of poor quality, and planters in boom years may rush to plant the varieties other than those that are standard.

It seemed to me that in the growing of the so-called Hickory Pryor by some planters in the season 1926/27 the above conditions were being fulfilled. I inveighed against this variety from early in 1926. I wrote on 17th March, 1926, to a prominent planter saying that this variety was not real Hickory Pryor but Harrison Pryor, whose synonyms were Big Jim or Make-all, and gave my opinion upon it. His reply was that a leaf manager of a large concern seemed to like the leaf, in fact, so much so that they had ordered 50 lbs. of the seed. "Plants were examined by this man, who I understand has had experience in America and I should say his position as leaf buyer would be some guarantee of his knowledge of leaf" (50 lbs. should plant 4,000 acres of leaf).

A report from a broker about that time said that "although it is everywhere conceded that the tobacco was faultless, the trade is not willing to pay this price for Nyasaland tobacco, and state if it comes to this figure they may as well use the real thing, meaning Virginian, as it shows no advantage." This refers to the Hickory Pryor tobacco. I wrote in *East Africa* of December 16th, 1926, saying that over-production may easily occur in this type of tobacco grown from Harrison Pryor, as the quantity used by manufacturers in blends can only be small. However a prominent broker again wrote in *East Africa*—on July 7th, 1927—saying that the results were highly satisfactory from the growing of this so-called Hickory Pryor or Pinkney Arthur.

Again, at the Tobacco Conference in Blantyre in early July, 1927, I received little support owing to apathy or ignorance of many present and owing to the presence of a certain broker who was emphatic that these varieties were the best to grow. I had expressed guarded opinions also in Circular No. 1 of March, 1927. It is conceded that such tobacco is of pleasant aroma and good burning quality, although naturally lacking in "gum" and elasticity, and the ripening is characteristic. The tobacco is brittle and there is much breakage in handling.

In view of the emphasis of these brokers I have recommended it in cases at high elevations where it was obvious certain standard varieties were not a success. The situation as I could see it was dangerous from many points of view, and the fact that large stocks of this type of leaf now remain unsold must be considered a serious matter. There is comfort in the fact, however, that large quantities of such leaf have been used for years by South African manufacturers.

We have—notably in Bulletin No. 2, 1927—drawn attention to the need of establishing definite types of Nyasaland tobacco which, grown from approved varieties, are likely to possess that distinctive colour, texture, burning quality and aroma which is usual in tobacco grown on the soils, at the elevations and under the climatic conditions upon which our type classification is based. Are we still to produce tobacco which can only be used as a small percentage in mixtures, cigarettes, etc., or definite and desirable types which will be sought after and have a definite supply from year to year? In my opinion such a type classification is essential if the industry is to progress on the right lines. The position in the Central Province where a dark-fired type is produced largely and successfully by natives is right, but elsewhere the position is very unsatisfactory. That a type classification is based on a continuous soil and crop survey is obvious.

It appears that production of an article of high quality is inseparable from real—i.e., diversified—farming, and that there must be a market for low-priced products of the farm, which means for Nyasaland a railway system direct to the coast. There is the practice of certain growers in a favoured flue-cured tobacco area of fire-curing crops at the dictate of some local buyer. The evils of a one-crop country were never more obvious. It is pointed out that the clearance of Empire tobacco at the close of 1927 was given at 23,000,000 lbs. This represents 14 per cent. of all tobacco cleared, and the opinion is now expressed by authorities, i.e., brokers, etc., who were urging the rapid extension of Empire growing that this 14 per cent. represents the point of balance between all Colonial and American tobacco.

Such statements by these so-called authorities are absurd, but we must not blind ourselves to the fact that over-production of certain types has come about. We can, however, by propaganda and otherwise get the trade to understand that numerous types of tobacco are produced, and that certain types are indistinguishable from their American counterpart.

Most dark tobacco, from Nyasaland can replace American leaf of the same type and grade almost entirely. The attention of all planters to the growth of certain standard varieties would go a long way towards placing the industry on a far firmer basis.

Points which must be considered if our industry is to progress in the right way are, therefore, as follows:—

(*a*) Careful selection of soil for the growth of dark or bright varieties. Many people would doubtless be offended if they were told that they should never have planted flue-cured tobacco on their estates, but such is the case. The mistakes were made at the outset of the industry.

(*b*) More attention must be paid to disease measures, to wildfire and angular spot at elevations above 2,800 feet, to frog-eye at middle elevations, and to non-parasitic diseases such as frenching and sand-drown at optimum elevations. (The disease control measures which in extension work we have continually brought before the planting community since 1923 have become regular practices on many farms).

(*c*) Careful selection of varieties. Cash and the right types of Gold-leaf are of distinct promise at middle elevations for flue-curing.

A word may here be said about the elevation at which tobacco was, and is, grown. When I first arrived in the country the crop was grown most largely at an average elevation of 3,000 feet. The tendency has since then been to grow more largely at lower elevations, and I have encouraged this tendency as I am convinced that at the lower elevations with an average of 2,000 feet we have climatic conditions and soils which are more nearly the counterpart of the tobacco sections of North and South Carolina, especially for bright tobacco. I have three times during the year visited lake shore areas in North Nyasa and the south-west areas of the Lake.

Time for planting out tobacco in the field.—At high elevations it is necessary to plant out the first acreage as early as possible and to follow up as soon as possible with later plantings to obtain the benefit of the higher temperatures for growth, and ripening and the benefit of plant food, which has accumulated during the dry season, before leaching with heavy rainfall has led to the need for far more fertilizers for a good yield. At middle elevations, taking the average of very many seasons, the need is not so great and, although it is useful to reap the above benefits of early plantings, there is still the benefit of a better ripening at fairly high temperatures and with less rainfall towards the end of the rains. I still maintain that true ripening which takes place some weeks after topping and which is accompanied by accumulation of starch and other compounds in the leaf is to be continually aimed at. There is still far too much false ripening, as I have called it, which is due to one of many causes, including starvation phenomena and root injuries due to eelworm, pythium or other diseases. While the later plantings might indeed encourage the nematode trouble it is possible to avoid starvation phenomena and to obtain true ripening in the drier months with later plantings. The leaf from truly ripe plants is of good composition and of most pleasant aroma when aged and is the counterpart of leaf of the corresponding American types. As regards these later plantings, it may be said that many nursery troubles are likely to occur in the later beds due to high rainfall.

Disease.—Damping-off organisms are likely to lead to stem-rot, pythium and phytophthora, and other diseases in the field. I have not, however, with good seed-bed sanitation suffered to any great extent from these organisms. Other organisms which I am of opinion originate to a great extent in the seed-bed are frog-eye and eelworm, and are carried on transplants. The frog-eye organism (*Cercospora*) does far more damage than is usually recognized and is responsible for the brown spot which develops in the barn —especially in later curings—seriously detracting from the value of the leaf. I do not seem to suffer in Zomba, although with a higher rainfall than certain other areas. I put this down to—

(*a*) The choice of less fertile soil for nurseries, where such organisms are initially less prevalent. Such soil has a smaller lime requirement but fertilizers are required. Thorough burning is carried out;

(*b*) The use of mat shades which are raised as soon as possible on wires;

(*c*) More attention being paid to spraying on smaller area of seed-beds;

(*d*) Priming off quickly lower infected leaves.

With regard to the stem-rot diseases, it may be difficult for planters to distinguish between these in certain seasons. Dr. Tisdale states that the girdling of the stems with decaying external tissue just above the surface of the ground and the discing and hollowing of the pith occur in plants attacked with *Rhizoctonia solani*, *Sclerotium rolfsii*, and *Phytophthora Nicotianae*. Dr. Butler has shewn that similar symptoms are exhibited by plants attacked with *Pythium aphanidermatum* in Nyasaland. *R. solani* and *Sclerotium rolfsii* have also been reported by the Assistant Director and others in Nyasaland.

Bacterial diseases which have been the cause of very serious losses in the tobacco crop in Nyasaland in the past, e.g., season 1922-23, were of very minor importance in 1927.

It is interesting to recall that the first year that Blackfire (Angular leaf-spot) assumed very alarming proportions was 1923, and measures for control of bacterial disease such as seed disinfection were brought before the planting community during a tour of the country. Whatever may be said for and against spraying of seed-beeds with Bordeaux mixture as a remedy against bacterial disease, it is certain that the practice results in more healthy growth, especially in late seed-beds, and the fact that the practice has become a regular operation on many farms is justified. The disease which causes the specking and brown staining in the flue-curing barn has been shewn by Dr. Butler to be due most largely to *Cercospora Nicotianæ*.

I gave as a remedy some years ago (*Nyasaland Times*, 1923) a modification of Ragland's "Sapping" method. This was to run up the barn to 120°F. as soon as it is filled with leaf which is suspected of becoming seriously spotted and perished. The suspicion is based on the fact that leaves of plants still in the nursery show very serious infestation and the lower leaves of the plant in the field show quite a number of frog-eye spots. Great care is taken not to go over the temperature stated—it may be read by a thermometer hung just over the flue near the fire-box. As soon as this temperature is reached the fires are withdrawn and the barn allowed to cool during the night. Next morning the fires are started for an ordinary cure or the "sapping" process repeated. When the temperature of 120°F. is reached in a shorter time in an ordinary cure it has been seen that less perished tobacco has resulted from this leaf spot.

There is the opinion that this process serves by killing the leaf tissue presumably round the parasite rather than by checking the growth of the parasite. There is the fact that leaf tissue which is killed by heat or protoplasmic poisons will not cure. There is, in my opinion, greater incidence of this disease on land where sand-drown is seen in certain seasons. The low availability of soil magnesia on such soils may under certain circumstances result in the plant suffering from a deficiency which makes it more susceptible, although such deficiency may not result in the full symptoms of sand-drown. There is, however, need for precautions to be taken to minimize the amount of infection as outlined above.

Scheme of Manuring for Tea Land.

Although there still remains much work to be done on the state of fertility of Nyasaland tea soils, fertilizing of tea is reviewed in the following pages.

Sources of Plant Food.—It has been shewn that precipitated bone phosphate on most Nyasaland soils is of equal availability and moreover has practically the same percentage of phosphoric acid as double superphosphate. It also travels in bags very much better. This phosphate then can be used as a fertilizer with advantage on most Mlanje and Cholo soils which show deficiency of available phosphates.

Muriate (chloride) of potash is to be recommended as a source of potash. There is the effect of the muriate on the composition and concentration of the cell sap and the absorption of magnesia by plants manured with muriate is in an amount greater than that absorbed by plants fertilized with sulphate. Plants manured with muriate are more drought resistant, and there is reported a beneficial effect of this fertilizer on leaves attacked by mosquito blight. Urea offers itself with advantage as a source of nitrogen on Mlanje tea soils, not only on account of the smaller freight and carriage charges but because it is practically of equal availability to sulphate of ammonia and only slightly slower in action than nitrate.

Scheme for increased crop production.—The scheme which I have recommended on Mlanje soils is that phosphates as above should be applied in October or November together with an annual application of nitrogen in urea. A mixture of muriate of potash and urea is reserved for the autumn (late wet season or March) application. An average annual application for plantations of some years standing would be:—

62 lbs. per acre precipitated bone phosphate,
80 „ „ urea in two applications (spring and autumn) of 40 lbs. each, and
100 „ „ muriate of potash.

It will, of course, be understood that cover crops and green manuring with crops such as bush lima bean, O-too-tan soya bean, bush velvet bean, *Vigna oligosperma* or burr clover is being carried on, such legumes being stimulated by the phosphate application. Planters must vary the above rate of applications according to the period the land has been in cultivation, to the condition of the tea bushes, to the prevalence of diseases and to the amount of rainfall before the autumn (March) application.

If land has only been opened a few years, the requirements in nitrogen and phosphates are very much less than subsequently as general rule, and for land between the second and fourth year after clearing, the average application as above may be halved.

Furthermore, a small rainfall of only from five to seven inches per month in February and March may be encountered, in which case there is very little nitrate and other salts removed by percolating water. In such a case the autumn application may be halved. The influence of the March application on the recovery of bushes after pruning will be further discussed.

The above fertilizers may be replaced by the equivalent of the new concentrated fertilizer diammonphos in such an application per acre as —

50 lbs. diammonphos in October,
50 „ urea with 100 lbs. muriate of potash in March.

Also, for planters who like the ready mixed fertilizers, the nitrophoska compound in equivalent amounts may be used, i.e. 110 lbs. per acre in October and 110 lbs. per acre in March.

Lime.—It will be noted that there is no lime contained in the latter applications. Mlanje and Cholo soils on which tea is grown show a very small lime requirement, and for the purpose of correcting this lime is rarely necessary. For tea soils, lime is generally considered to be harmful except in small amounts though in Assam lime is regarded more favourably. On certain soils in Nyasaland there has been marked benefit from magnesian lime (see Bulletin No. 2 of 1925). In view of the above remarks on magnesia starvation and with the idea that tea needs an abnormal value of the ratio MgO CaO in the soil, and requires the magnesia in marked excess, it is proposed to include a small application of magnesian lime, e.g. 500 lbs. of ground magnesia limestone per acre being applied every two years. The effect of the muriate also should thereby be much increased.

It must be thoroughly realized that there is a large strain on the tea bush during its growth as the leaves are removed at flushing time and so prevented from performing their normal synthesis of carbohydrates, which eventually form starch, woody fibre, etc., in the roots and stems and which feed the young growing points. The great strain is soon indicated in badly managed tea by the poorer wood growth and the susceptibility to disease. In this connection may be pointed out the part potash plays in the translocation of carbohydrates to growing points and to where wounds * are being healed by callus tissue.

The function of the phosphates in promoting root development has led us to apply such fertilizers in October or November, but the potash is applied in March as it is likely then to have its maximum effect. Keiller has pointed out that if a cut surface is once encrusted by a ring of actively growing callus the wood in the centre does not decay although it may take many years before it has completely healed.

This gives support to the view that the healing of new pruning cuts and the repair of damage already done by the old ones are under our peculiar climatic conditions best induced by the March "pruning" application advocated by us since early 1926. Such a view is also supported by Mr. S. P. Wiltshire in the Annual Report of the Long Ashton Station, 1922.

Swabrick has pointed out in England that at some stage after pruning cuts on trees the starch in the cells of the wood just below the cut is transformed into a gummy substance which blocks the wood vessels and forms a sealed layer across the surface itself, preventing penetration by disease germs. This sealing only takes place to anything like completion when the tree is in active growth, and branches pruned in autumn and winter remain open to infection until active growth begins in April and May, i.e. in England, whereas those pruned in the latter months are sealed within a week, the sealing being accompanied by external callus growth. To stimulate active growth for this purpose requires such an application as we have shewn above after the heavier rains of February and March. The bush should recover more quickly from pruning, and stimulated callus growth should more quickly throw off dead and decayed tissues.

"*Sick*" *Tea.*—A general mixture which may be applied to sick tea each year at the beginning of rains is as follows: –

72 lbs. urea,
66 ,, muriate of potash, and
72 ,, precipitated bone phosphate per acre.

This represents an application of one ounce per plant, which may be applied in a ring dressing. This, however, does not mean that the March application may be omitted as it may be some time before such sick tea recovers its full bearing power. The rate of application of this mixture may be varied according to the judgment of the estate manager with regard to the state of tea.

At transplanting.—The application of such a general fertilizer as this at the rate of 1 oz. per young plant will soon be a general practice in Mlanje at transplanting time.

Equivalents of Nitrophoska.—It may be noted that the nearest equivalent of the above mixture in the new nitrophoska compound with formula 16.5-16.5-20 is 200 lbs. per acre. The nitrogen in nitrophoska is in similar forms to that in diammonphos and urea, and is just as quick acting.

Nurseries.—It is said that certain diseases of tea are caused by soil deficiencies. The importance of obtaining young disease-free plants for transplanting need not here be stressed. Various blights and red rust are encouraged by potash hunger. *Macrophoma* disease is often seen on poorly grown plants in the nursery. Nursery plants at certain periods sometimes become very yellow.

It is still maintained that the best way to fertilize nurseries to ensure good tea transplants is to give two applications of a compound water or citric soluble fertilizer at the commencement of the main rains and in the autumn (March) after the heavy rains. For example, nitrophoska 16.5-16.5-20 compound or mixtures of phosphate and urea in spring and urea and potash in March.

About four ounces, i.e. two handfuls of nitrophoska compound is stirred well in four gallons of water in a can, and when the salt has mostly dissolved the four gallons may be poured over ten yards of bed and then well washed off the leaves with plain water. The equivalents of the nitrophoska compound are found in the above lists. Large seed bearers may be given 4 ozs. per tree of such compound fertilizers or the equivalent. This is well mixed with the soil a few feet away from the trunk.

Soil Erosion.—It is gratifying to observe since 1924 the increasing adoption in Mlange of ridge terraces and drains for preventing soil erosion as outlined in our Bulletin of December, 1923. It is still maintained, however, that graded ridge terraces and drains with a small gradient and outlet are superior to the level ridge terraces with a blind drain or long silt pit beneath. The following facts must be considered when it is realized that soil erosion becomes far worse as years elapse from the time of clearing.

* Pruning is carried on annually from April to August, the earlier the better.

Soils in Mlanje and Cholo when they are first cleared of virgin forest contain to a great depth root systems which on decay lead to natural drains and give good absorption of tropical rains. The fibrous roots also for a time hold the top soil together. The roots of a large tree may decay or be eaten by white ants. There results a series of pipes, leading to great depths, which rain-water easily fills, and the water is gradually absorbed by the surrounding soil. The absorption of rain-water falling on the soil surface is very large. After a certain time the roots decay and ferment away completely; the spaces occupied by this decaying matter are filled with small particles and the absorption of water by the soil and subsoil becomes very small. Unless, therefore, there are provided means of preventing soil creep on slopes and of preventing surface water running off and taking much valuable material with it, tea gardens after a few years give poor yields through resulting soil poverty, or many individual bushes become susceptible to disease.

A further factor leads to increased soil washing. The lower root zone of the original forest growth may, after complete decay of the roots, become thoroughly impregnated with compounds such as hydrated oxides of iron and aluminium which form a pan practically impervious to percolating water. This often happens beneath lateritic and so-called eluvial soils of high rainfall areas in Nyasaland. Such a pan naturally leads to very serious impoverishment of the soil above with resulting poor yields and certain diseases of tea. The evidence is in favour of graded ridge terraces and drains to a depth of two to three feet as a means of promoting better growth and of preventing soil erosion.

Soil Analyses.—The value of soil analyses by several methods is discussed in Bulletin No. 1. Too much reliance cannot be placed on analyses by the strong acid or 1 per cent. citric acid methods, but they are useful as indications, and when numerous analyses show such a low percentage of easily soluble phosphoric acid in the lateritic, lateritic transition soils and laterites of Mlanje, phosphates, as in the general formulas above, may safely be recommended. Potash is not likely to be deficient as indicated by such analyses, but then the superior physiological effects of muriate of potash or sylvinit make applications worth while. Such applications also ensure that potash starvation is most unlikely. The total nitrogen, lime and magnesia in a soil of course give us no indication of when hunger for these elements by the tea bush will occur.

The tables herewith give typical analyses of tea and coffee soils:—

TYPICAL ANALYSES OF NYASALAND TEA AND COFFEE SOILS.

	Mlanje				Cholo		
Cores	Soil ins. 0-9	Subsoil 9-18	Soil 0-9	Soil 0-9	Soil 0-9	Soil 0-7	Subsoil 7-18
Organic and volatile matter	18.06	19.54	11.85	20.33	8.22	9.18	8.80
Iron oxide and Alumina	15.90	—	12.70	—	17.14	11.1	10.25
Lime	.31	—	.25	.28	.18	.21	.32
Magnesia	.29	—	.21	.16	.30	.36	.46
Potash	.31	—	.38	.19	.31	.36	.49
Phosphoric oxide	.084	—	.13	.34	.19	.21	.12
Total Nitrogen	.201	.151	.148	.004	.136	.125	.055
Available potash	.015	—	.032	.012	.0195	.024	.008
Available phosphoric oxide	.009	—	.017	.027	.025	.012	.005
Lime Requirement* (H & L)	.18	—	.154	—	.112	.11	...
(Hopkins)	.006	—	.008	—	.004	.014	...
P.H.	5.6	5.7	5.8	5.4	6.2	6.2	.645

The humus in these soils varies from 0.2 to 0.8 per cent. (method Khartoum Laboratories). The salt content is negligible rarely exceeding 0.1 per cent. The above analyses have been made from time to time.

As one leaves the soils near the Mlanje Mountain, which have been covered with a very superior mantle of vegetation, there is a more distinct change at a few inches below ground level and the content of nitrogen and organic matter appreciably diminished. This is well seen in the seven-inch deep tea soil of Cholo, where the nitrogen content of the first nine-inch layer of subsoil is less than half that in soil proper. Although analyses of these soils indicate that they are more fertile than many Ceylon and Indian tea soils and should give large yields when properly managed, it may be as well to study some of the properties and to explain the low yields often obtained.

As typical analyses it will be noted that the amout of available phosphoric oxide is low in comparison with many other soils in Nyasaland. I know, however, of no soils of the Tuanjati, Michiru and Vua series noted for high availability of phosphates occurring in the tea areas, although this may be the case. Potash is not likely to be a limiting factor for growth of tea anywhere, while total lime and magnesia are present in fair amount. The latter give us little idea as regards the proportion of easily soluble lime and magnesia, although there is a connection between the amount of available phosphates and this proportion. Furthermore, as has been pointed out, sand-drown (magnesia hunger) of a large number of tobacco plants has been seen on many soils with greatly varying lime and magnesia contents, and it is likely that tea and coffee suffer from magnesia hunger under certain conditions on all the above soils. There is an opinion that tea requires magnesia in marked excess, and magnesian limes have given good results in Mlanje.

* By method of Hutchinson-McLennon, 17 samples of soil showed a lime requirement ranging from 0.06 to 0.29 per cent. averaging 0.126 per cent. The lime requirement indicated by the method of Hopkins was almost negligible.

It may be interesting to compare the rainfalls of seasons 1925-26 and 1926-27 on a soil similar to Cholo soils above, on which tobacco suffered severely from sand-drown or magnesia starvation in 1925-26 but showed none in 1926-27, and no difference in plots (in 1926-27) manured with sulphate of potash, muriate of potash and double manure salts, or on plots of different varieties.

	1925-26	1926-27
September	1.08	—
October	2.64	.77
November	6.71	2.76
December	12.06	15.55
January	27.99	11.39
February	12.80	10.83
March	14.43	7.12
April	2.72	6.34
	80.43	54.76

Although tobacco may have very different feeding powers to the tea bush, the figures herewith give us a very good indication of how available magnesia is influenced by a tea-belt rainfall, and this is most likely to apply to magnesia available to many species of plants.

Mlanje soils are stated to be derived mainly from the orthoclase-hornblende-syenite, but as has been shewn in many parts of the world climate has most influence on soil formation, and under such a rainfall the main soil groups as noted above are most prevalent in the Mlanje and Cholo tea-belts. Only on the outskirts of the areas are red loams, chernozems and transition soils found. Soil analyses for a classification of these main groups in tea areas are lacking in most parts of the tropics.

It seems that the soil analyses arrived at by the "acid" methods should not be carried out for any individual planter or isolated fields, but that samples for analyses should be representative of types and series covering large areas. At any rate the formula recommended above should be shortly submitted to rigid field tests.

The following data of rainfall are published for information :—

AVERAGE MONTHLY RAINFALL.

	Ruo Estate, Mlanje. Average 1913-1926		Cholo. Average 1913-1924
	Inches	Days	Inches
January	13.02	20.28	8.94
February	15.07	19.92	10.11
March	15.78	20.00	7.97
April	7.93	13.78	4.08
May	4.39	9.94	2.42
June	2.27	7.35	1.20
July	2.31	0.85	1.48
August	1.72	6.07	.97
September	.97	2.57	.27
October	2.95	5.71	1.98
November	6.73	10.71	4.18
December	12.35	16.64	9.04
	85.49	139.52	52.64

A. J. W. HORNBY, Agricultural Chemist.

Report of the Government Entomologist.

The work of the division for the year has been mainly concentrated on the two subjects of Root Gallworm in tobacco seed-beds, and the pests and diseases of tea. The latter work was continued from the previous year and as regards the diseases of this crop was made noteworthy by the visit, in the early part of the season, of Dr. E. J. Butler, C.I.E., Director of the Imperial Bureau of Mycology, under whose guidance many of the hitherto puzzling problems connected with this subject were made clear. A short period during June and July was spent in accompanying Mr. W. Nowell, D.I.C., Director of the Amani Institute, through the country.

Tobacco.

The season 1926-27 has been largely covered in the last annual report. The outbreaks of Surface Beetles mentioned therein appear to have been somewhat generally distributed over the country, and it would seem that there is some obscure connection between the appearance in numbers of these beetles and the state of the lands in which they occur. Some kinds appear most numerous in weedy fields, others appearing quite as numerous on quite clean lands. I adhere, at present, to my opinion that lands kept clean for *two weeks or more* prior to planting are less likely to suffer from attacks of these beetles than dirty lands, but there is certainly some unknown factor influencing their abundance in different years.

The 1927-28 season commenced in an extremely satisfactory manner, and with the exception of a slight attack of millipedes in one area no particular record of serious damage by pests was received. This attack by millipedes was not easy to explain, but there was no doubt that the newly set-out tobacco plants were being destroyed by them, as a similar destruction was produced by them in captivity on healthy tobacco plants. Coupled with this pest there were some wireworms (the larvae of certain Tenebrionid beetles), and also Therevid larvae. Some of the wireworms were the larvae of *Zophosis agaboides*, Gerst., and probably of *Distretus* sp., the remainder being raised in captivity have not yet reached maturity. It has been noted on previous occasions, notably in 1923, that an attack of wireworm is frequently accompanied by the presence of the larvae of a Therevid (a two-winged fly). The association has not been made clear, as in captivity these fly larvae seemed neither to feed on the tobacco plants nor on the beetle larvae, though in all probability they are carnivorous on the young stages of the latter. A very light application of calcium cyanide was made to the ridges of a portion of the tobacco field so attacked, and though full benefit was not obtained owing to the small quantity of the chemical used, it was sufficient to demonstrate that if it were possible to use some 800 lbs. or more to the acre considerable relief from the depredations of these soil insects would probably result. Many of the surface beetles have the habit of lying quiescent when disturbed and this habit renders the hydrocyanic acid gas emanating from the calcium cyanide rapidly fatal to them; but the active larvae and other insects, such as grasshoppers, are able to escape from the influence of the gas unless a sufficient quantity of the chemical is employed thoroughly to impregnate the whole area. To do this under local conditions would, appear, as yet, to be too costly for practical recommendation.

The work on root eelworm in tobacco seed-beds was mainly concerned in discovering the effective penetration through the soil of the heat produced by the methods of firing seed-beds normally adopted in Nyasaland. The conclusions reached in this work, together with the results obtained from the employment of various chemicals for the purpose of eliminating *Heterodera* from seed-beds during experiments carried out since 1925, were put together as a preliminary bulletin on this subject (Entomological Series, Bulletin No. 3), to be issued early in 1928. This bulletin deals with the life history and habits of the root eelworm and discusses the various methods of control that have been suggested in various countries. The chemicals experimented with in the field were cresylic acid, and dinitrochlorbenzene. The conclusion was reached that neither of these chemicals was of practical value under local conditions, as any beneficial effect obtained, even from heavy dressings at a high cost, did not last for more than one season. The values of certain local vegetable poisons in controlling root eelworm were also tested. It was found that the common fish poison, *Tephrosia vogelii*, had no permanent effect on the worms; equally ineffective was the root poison "namalaluka" (*Acacia* sp.). A second root poison, however, from a species of *Mucuna* ("liwiinje"), appeared to have a rapid effect on them, and to eradicate them completely from soil cultures saturated with a 10 per cent. aqueous solution of this root. This plant is not excessively common, however, and it is difficult to see how it can be turned to practical advantage. Further experimental work is very desirable, as it has only been possible to test this poison on small cultures. Sodium fluoride, in weak solution, was found to kill root nematodes extremely quickly and also to have the power of eradicating them from soil cultures. Again it is difficult to see how this chemical can be turned to practical account, as it cannot be utilized on growing plants. In order that the germination may not be affected, a short period must be allowed to elapse between the application of the chemical and the sowing of the tobacco seed, and experience has shewn that the root nematodes are not as a rule in evidence at the beginning of the nursery season but become very prevalent toward the end of December. Thus, to be successful the treatment must eradicate the pest to such an extent that no eelworm develop during the successive three months or more. It must exercise a permanent effect over this period, which is a serious demand when the very suitable nature of a tobacco seed-bed for the development of root eelworm is considered.

Investigation into the temperatures reached at different soil levels when seed-beds are burnt proved that rarely is a temperature reached below six inches sufficiently high to kill root eelworm. The minimum effective temperature obtained was 135° F. retained for 45 minutes, and temperatures of 128° F. and 108° F. retained for fifteen minutes and two hours respectively did not kill the nematodes. Points of interest that have materialized during these experiments are that a heavy covering of grass and brushwood gives as effective a heat penetration as logs of wood: that watering the soil immediately prior to burning may render the penetration of the heat negligible if the soil is very light. Continuous watering of the soil for some time before burning may have the effect of inducing the root eelworm to assume an active form in which it is more easily killed by heat or take up a position in the upper surfaces of the soil where the heat penetration is most effective. But it has not been feasible as yet to experiment on these lines. The work devised to discover, if possible, whether there was any particular migratory movement of root eelworms from the lower to the shallower soils during the nursery season has unfortunately not given any results this year, considerable difficulty being experienced in making suitable apparatus from the local materials available. It is hoped, however, that information on this point will be obtained later.

Two small experiments carried out with cyanogas (calcium cyanide) during the season 1927-28 gave very disappointing results, due in part to the dryness of the period, which inhibited the normal development of the pest. Indications were obtained, however, that a heavy application of the chemical is necessary, and that a shallow treatment (three inches) is more effective than a treatment made only slightly deeper (six inches). The use of the chemical cannot supplant the burning of the beds. All the information obtained from observations on seed-beds points to the fact that the soil temperature is very largely the controlling factor in the development of root eelworm. A tobacco seed-bed with its continuous moisture from September onwards, its shade, and its abundant food supply forms an ideal breeding-ground for the pest. Moreover, records show that the soil temperatures of seed-beds coincide very nearly with those most suitable for nematode development, and that at the time when root eelworm is most prevalent in tobacco seed-beds, December and January onwards, these temperatures most closely approach one another. Hence the very great importance of clearing up nurseries by the month of February to prevent excessive infestation of the soil by the pest.

Tea.

This crop continues to remain amazingly free from insect pests. Work on the tea mosquito bug (*Helopeltis bergrothi*, Reut.), was continued in the early part of the year, but the bug was scarce and in comparison with the previous year negligible. Sufficient data has been collected concerning this insect and another potential pest of tea, the Tea Leaf Weevil (*Dicasticus mlanjensis*, Mshl.), to warrant the publication of a small bulletin, which, with illustrations, should serve the purpose of bringing to the notice of planters newly launched in this crop the possible damage resulting from any serious outbreak of these pests. This bulletin should be ready for publication in 1928. The influence of climatic conditions on the prevalence and destructiveness of tea mosquito bug as suggested in last year's report is amply substantiated by records for the years 1922-1927. The "degree of wetness" for each month of these seasons, October to September, has been obtained from the formula $(R \times n) \div N$, where R = the total rainfall for the month, n = the number of rainy days in the month, and N = the number of calender days in the month. From these figures it is found that in the two seasons 1922-23 and 1923-24 the highest degree of wetness for any one month was 11.507, reached in February 1924, and in only one other month during the two years, namely, March 1923, was a double figure (10.813) attained. In the season 1924-25, however, the degree of wetness in January reached 19.75, in February 15.703 and in April 13.496. In the following season the degree of wetness for January was as high as 22.938 and in March 15.538. This season, 1925-26, was the one when mosquito bug was most prevalent and doing most damage. During the last season, 1926-27, when the insect was negligible, only one month had a degree of wetness running into double figures, namely, March, with 13.575. The total rainfalls during the two seasons 1924-25 and 1925-26 were, respectively, only 1.61 inches and 13.69 inches higher than the rainfall in 1922-23. Thus it is reasonable to conclude that the two seasons in which the month of January had a particularly high degree of wetness, followed by months in which this figure was greater than previously recorded, influenced the increase of the insect, which culminated in 1926. Further examination of these figures shows that in the two seasons concerned with the outbreak of mosquito bug the degree of wetness rose rapidly from the commencement of the rains to a maximum in January, whereas in the two previous ones there was a considerable drop after December and the highest degree of wetness was not reached until March or February, and in addition in 1926 a second very high point was reached in March. This probably accounts for the reason why the main tea flush in this year escaped the greatest abundance of the bugs. But, as pointed out in the annual report for 1926, climatic conditions producing and maintaining continuously a high degree of wetness during the very early months of the season will open up the main tea flush to the full force of the insect attack.

The Tea Leaf Weevil (*Dicasticus mlanjensis*, Mshl.), was found to be a very prolific egg-layer; one female producing 1,823 eggs in 47 days and another over 2,500 eggs during a period of six months. The grubs, which burrow in the soil immediately on hatching, do not at present seem to favour tea roots as a food, so that the combined damage between the adults on the foliage and the grubs on the root system has not yet developed. The eggs, which are laid in batches averaging about 60 under the folded back tip of a leaf or between two leaves glued together, always at the summit of a bush, hatch in 7-10 days at the beginning of the season and in 20-30 days later on. They are parasitized by a chalcid, as yet unidentified.

A small black weevil (*Systates*, sp. nov), having exactly similar habits to the above, has been found devouring tea foliage under similar conditions. But it is not numerous and is of doubtful importance. Should necessity arise both the adults and eggs of these weevils could easily be hand collected.

Another sucking bug (*Callicratides rama*, Kirby), has been found ovipositing in tea shoots, but could not be induced to feed on the leaves if bean flowers were available. Its predeliction for bean flowers invites the name of the "Bean Flower Capsid," and as it is recorded from Ceylon as attacking tea a short description of it will be given in the above-mentioned bulletin.

The use of beans as a cover crop amongst tea provokes quite an interesting entomological question. Will any of the myriads of insects that feed on some portion or other of the beans develop a taste for parts of the tea bush? The two weevils just mentioned have undoubtedly done most damage to young tea bushes after a cover crop of beans has been removed. The Bean Flower Capsid selected tea shoots in which to oviposit but fed entirely on the bean flower, yet it attacks tea in Ceylon. The large Black Bow-legged Bug (*Anaplocnemis curvipes*, F.), is much attracted to beans and will also suck young tea shoots, producing wilted tips. Many other cases could be cited. Partly on account of this possibility and partly for purely agricultural reasons an attempt is being made to establish burr clover in the tea-belt, with a view to trying out its qualities as a cover crop. Small quantities of seed of an indigenous Crotolaria (probably *incana* sp.), growing to a height of 12 to 18 inches, have been distributed for the same purpose.

Damage by Termites to young plants is a disquietening factor. Although in some cases it was obvious that unhealthy plants were attacked, in other cases there appeared to be no reason to assume that the plants were in anything but a flourishing condition, and the reasons for such attack are obscure. Under certain circumstances there is no doubt that improved drainage would assist the development of the plants and decrease conditions favourable to the white ants, although the general appearance of the area may not indicate the necessity for further drainage. Otherwise it can only be suggested, very tentatively, that the seasonal time of planting, or the conditions—climatic, field preparation, etc.,—*at* the time of planting are at fault. Experiments with cyanogas—calcium cyanide—showed that this chemical could not be applied in sufficient strength to destroy or drive away the termites without being detrimental to the bush. The white ants in question have, by the courtesy of Mr. Claude Fuller of the South African Division of Entomology, been classified as belonging to the following groups:—

Acanthotermes, *Ancistrotermes*, and *Microtermes*, and possibly contain new forms as well.

These termites make no obvious nest, but emerge from the soil close to the collar of the young plant, proceed to climb up the main stem under cover of an earthern run-way and enter this stem or the lateral branches at some convenient point. These stems become completely hollowed out, the upper part of the plant is cut off and falls down.

Applications of the chemical to be effective must be made so close to the collar of the plant that any living portion left above ground is killed. It is true that many plants so treated will produce new shoots from below ground level, but the resulting bush is liable to be of a straggling type, and the old original snag is a point for the commencement of further white ant attack, and for the entry of fungoid diseases. Applications of $\frac{1}{2}$-$\frac{1}{8}$ oz. of cyanogas were sufficient to rid the plant of termites, but at the lower rate was only efficient if placed so close to the plant that damage from it followed. As a preventive, placed in the soil two inches from the stem so as not to affect the plant, its value was only of a few days duration.

Tea Diseases.—In view of the visit of Dr. E. J. Butler during the year, extensive reference to to the diseases of tea in this report are unnecessary. It will suffice to say that, generally speaking, the ordinary stump roots are now readily recognised and promptly dealt with. Where much *Armillarea* exists campaigns of eradication have usually been instigated. The fungus has now been found on *Cedrela toona*, *C. odorata*, *Casuarina*, *Tephrosia candida*, "Hill" Tephrosia, and Mangoes, as well as the other plants and trees previously recorded. The infection of the Tephrosia plants occurred in tea fields that had not been properly stumped, and it appeared that infection had passed to them from these stumps *via* the infected tea bushes. Coppiced Cedrela stumps, however, are a direct source of infection. In one estate visited, *Ustulina* by itself, had killed a large number of young plants newly set out in the fields, and presumably these plants had been originally attacked in the nursery. One stump of *Tephrosia vogelii*, left in a "bund" after the plant had been cut down was found to be infected with this fungus. *Rhizoctonia* is responsible for considerable loss in nurseries, and it seems necessary to emphasize again the importance of opening up nursery sites so as to allow free air circulation through them and the maintenance of equable temperatures and humidity. "Caking" of the surface soil of a nursery bed is frequently met with, and such a condition should never be allowed to exist.

Some ten bushes suffering from what may be termed the "Unknown Disease" in various stages were marked and observed from time to time throughout the year. No particular treatment was accorded these bushes, with the exception of two which received applications of about 40 lbs. of lime and kraal manure in August and one of which was pruned at the same time. Early in 1928 neither of these bushes appeared to have benefited by the treatment. Of the remainder, by the same time only two showed any signs of improvement from the time when they were marked in April, 1927. One of these, an Indian plant, had almost completely outgrown the mottling which was apparent on two shoots in April, and the other had a slightly general better appearance. All the others had deteriorated or remained the same. This work is continuing. Whatever opinion may be held as to the advisability or otherwise of removing prunings there is no question but such action facilitates an early deep hoe, which is otherwise hampered by the mass of unrotted twigs and shoots.

Coffee.

Little consecutive work has been possible this year. The measures for dealing with the White Stem-Borer (*Anthores leuconotus*, Pasc.), described in the last report, have been continuously advocated, and where such have been definitely carried out there is no doubt that this beetle has been reduced from being a serious menace to comparatively minor importance. It still remains to find the original food plant of this insect, and although a number of suggested cases have been investigated none have proved correct. The Black Stem-Borer (*Apate indistincta*, Murray), again made a few sporadic appearances.

The Orange Stem-Borer (*Dirphya nigricornis*, Oliv.), to which only slight reference was made in the last report, has been bred up. The grub of this beetle has a more elongated appearance owing to the body segments being more rounded and the constrictions between them being more pronounced than is the case with the grub of the White Stem-Borer. The colour is a reddish-yellow. The adult has an orange-coloured head and thorax, and the legs and bases of the wing cases are the same. The remainder of the wing-cases, the eyes and antennae are dull black. This grub only remains in the coffee plant for one year. The egg is laid at the summit of the bush, and the grub bores into the very middle of the stem and from this high position tunnels down the centre to the very tip of the tap-root. At the upper portion the grub makes a series of circular holes from its tunnel to the exterior, and from these holes falls the frass and sawdust seen lying on the ground round the base of the plant. In all cases as yet investigated the end of the tap-root was bent up almost at a right-angle, and this bad planting may have had some effect on the plant which influenced the female beetle to select it for oviposition. The beetles may be collected during the commencement of the rains, but apart from the lines of holes described above, which are made early in the life of the grub, there will be no indication of attack until the dry weather sets in when the leaves turn yellow and droop, by which time the grub will have penetrated far down the stem. The adult beetles emerge at the beginning of the rains from a completely circular hole cut in the collar of the bush just below ground level.

As regards the stem-borers of coffee, the White Stem-Borer in particular, it must be recorded that a rather difficult position is likely to arise unless keen interest in the checking of these pests can be aroused amongst those concerned. Where coffee is being established as a definite crop it is reasonable to expect that the owner will adopt the measures recommended for the control of these insects, or other measures that may be found equally effective. But it cannot be denied that under some circumstances coffee has been, and is, planted where there is no intention of giving it proper cultivation and care. Such neglected areas become useless in a few years and are then abandoned. And they at once become an immense breeding-ground for the stem-borer. Again, small plots are established with a view to providing a supply of coffee for the household. These could be kept free of stem-borer with the greatest of ease, but the fact remains that often they are not. All such cases are a tremendous menace to those engaged in the real cultivation of this crop. The fact must be faced that under Nyasaland conditions the White Stem-Borer will always be present, as it is an insect that thrives best at the altitudes where coffee is grown in this country. Hence the necessity for taking action against this pest each year on very definite lines. Neglect of such work, or simply abandoning a coffee garden that has ceased to yield, should be looked upon by all concerned as a mark of extreme inefficiency and as setting up a very grave danger.

For those coffee planters who consider shade trees may be beneficial, *Acrocarpus fraxinifolius* merits a trial. I desire to record my opinion that a suitable shade tree, judiciously planted and properly attended, will assist successful coffee growing in Nyasaland.

Miscellaneous.

A sudden, isolated outbreak of a brightly-coloured, blue-green weevil, *Systates sexspinosus*, Mshl., occurred on a small area of maize in the early part of the year. Dusting with paris green and flour was successful, if heavy rain did not immediately follow the application. Cyanogas dusted into the leaf sheaths rapidly killed the plants as well as the insects. The weevils feed on a variety of weeds, particularly "chanzi" *(Acrocephalus* sp., *Labiatae)*, "chikongwe," and "mpolowani." It is unlikely that this insect will be more than an occasional pest of maize.

An attack of Cottony Scale (*Icerya seychellarum*, Westw.) on roses in Mlanje was found to be almost completely controlled by the Coccinellid beetle *Novius obscurus*, Wse.

Cyanogas—calcium cyanide—has proved to be an unusually efficient preparation for eliminating white ants from the brickwork of houses. Liberally used in verandas and walls where an aperture can be found that will allow the powder to descend to some depth, the complete eradication of the termites is reasonably certain.

Conclusion.

The past year has again been one in which the increase and development of the entomological collection has been seriously handicapped by the insistent calls of field work. The value of a good reference collection, not only of economic insects but of the insects of the country in general, cannot be overestimated. The provision of demonstration cases setting forth the more important pests of various crops with the parts of the plants they attack is a matter that I consider of infinitely more assistance to the practical planter than numbers of written papers. But such work requires a great deal of time and preparation, and if some particular subject arises necessitating a personal visit to a distant area under present circumstances all such work has to cease, possibly for a considerable length of time. In dealing with living insects the cessation of observations on the subject for only a few days may mean that another year must be spent in obtaining the desired information. Thus the continuity of work on a short-period, annual crop such as tobacco, coupled with the diverse climatic conditions experienced in Nyasaland from year to year and within the country each year, becomes difficult to maintain. No purely native assistance can be of value in taking accurate records or making accurate observations.

Colin Smee, Government Entomologist.

Corrigenda And Addenda to the Annual Report, 1926.

Page 14. 1. 4. Myrmecine Ant = *Pheidologeton* sp.
„ 15. 6. 3. *Dicasticus*, sp. nov. = *D. mlanjensis*, Mshl. (See B.E.R., Vol. XVII, p. 212.)
„ 17. 1. 7. from bottom *Aularches*=*Phymateus viridipes*, St.
„ 19. 6. 3. *Apate* Sp. = *A. indistincta*, Murray.
„ 19. 6. 4. *Dirphya* sp. = *D. nigricornis*, Oliv.

Report of the District Agricultural Officer, Fort Johnston.

I returned from leave on February 20th of this year and proceeded to my station at Fort Johnston. Below is a brief summary of the work covered from the date of my return until the end of the year.

Meteorological.—The season's rainfall, November 1926-April 1927 was 40.30 ins., i.e. 2.02 ins. less than in the season 1925-26, but 10 ins. above the average for the last twenty years.

Agricultural. -The work has been divided into —

District Agricultural Work: (*a*) native cotton industry: (*b*) general agricultural education.

Experimental Work (native foodstuff crops, etc.).—This work has been carried on at Ntumbwasi 2 miles from Fort Johnston, a station of five acres which I opened in 1925. Recently another five-acre experimental area 1¾ miles from Fort Johnston has been opened up with the object of studying the problems of growing dark and bright tobacco on the lake shore areas—rotations, etc., are included with the tobacco experiments.

Cotton Season 1926-27.—After rising from a district production of 31,999 lbs. in 1923 to 312,387 lbs. seed cotton in 1925, the industry has fallen off disastrously, for in the year just ended only 9,132 lbs. of seed cotton were produced in South Nyasa. The main contributing factors influencing this decline are:—(*a*) The flooding of the Malombe and consequent loss of South Nyasa's possibly most potential food producing area; (*b*) The fall in the price paid for seed cotton.

This unhappy situation arising out of (*a*) was greatly against cotton growing on east and western Malombe for, in both areas, most of the land not under water, or so soggy as to be useless (save for rice), was urgently required for the cultivation of foodstuffs, and where suitable land did exist in generous acreage the Native, for the most part, apparently considered the fish industry a more lucrative and congenial occupation than that of cotton cultivation, and especially so at the lower price per pound offered this year.

Flooding likewise materially affected the cotton situation in the south-west arm (Malombe area) though in this case the flood waters were of a more ephemeral nature, abating as they did with the cessation of the rains, and consequently did not bear nearly so acutely on the general falling off here as elsewhere; the reduction in price per pound of seed cotton might in this instance be taken as the predominating factor adversely affecting cotton cultivation.

With South Nyasa's best cotton producing areas so jeopardised with regard to this crop and the remaining sections of the district tending toward a greater foodstuff production, concurrent with dissatisfaction at cotton prices, the present situation is not difficult to understand. I am, however, hopeful that interest in this crop will be revived.

Mapira.—Personal observation gives reason to fear deterioration in the acre yields of the very popular native foodcrop of mapira (*Sorghum vulgare*), and steps are being taken to investigate this and to endeavour to check any fall off in yield by deprecating the malpractice of excessive continued ratooning and by distributing fresh seed. Work of this nature comes under the general heading of agricultural education, and I should here like to express appreciation of the ready co-operation and valued support rendered me by Mr. A. C. Kirby, the Resident, and to thank him for the keen interest he has taken in matters agricultural and in my work generally.

Ntumbwasi Experimental Area.—Observation plots of the various varieties of sorghum grown in South Nyasa gave interesting results in yield comparisons. I herewith tabulate the varieties which have been collected in the district:—

1 Nnunje—*Sorghum guineense*, Stapf., var. *involutum*, Stapf.
2 Malalemba „ „ „ „ „ „
3 Nandonje „ „ „ „ „ „
4 Nankupi „ „ „ „ nov., near *robustum*, Stapf.
5 Mikota—*Sorghum* sp. intermediate between *S. caudatum* and *S. bicolor*, Moench.
6 Kabiliwili—*Sorghum bicolor*, Moench, var. nov.
7 Mapemba woyera—*Sorghum guineense*, Stapf., var. *involutum*, Stapf.
8 Mapemba wofira „ „ „ „ „ „
9 Litimbulangau „ „ „ „ „ „
10 Lupira—*Sorghum caudatum*, Stapf., var. *schweinfurthii*, „
11 Kapili „ „ „ „ *Angolensis*, Stapf.

Further types collected are to be grown for observation purposes.

Maize (*Zea mays*).—A comparative trial of Potchefstroom Pearl maize against Mkozi (the local maize) resulted in an interesting set of figures; the experiment is being repeated.

Ground-nuts (*Arachis hypogaea*).—For two successive seasons the local nut Ntedza wenandi has proved a high yielder here as shown below:—

	1926	1927	Average yield per acre.
Spanish bunch nut (Namiwawa) ...	770 lbs ...	not grown ...	770 lbs
Chimwila (Zomba-Naisi) ...	800 „ ...	980 lbs. ...	890 „
Ntedza wenandi (Fort Johnston) ...	940 „ ...	1,440 „ ...	1,190 „

Finger-millet (*Eleusine coracana*).—Of the eight varieties grown in one-twentieth acre observation plots, the early maturing variety (3½ months) Kangumba from the south-west arm of the Lake has for two years running proved to be the heaviest yielder under Fort Johnston conditions, its yield this season being 1,040 lbs. per acre whilst the other varieties only produced

from 420-760 lbs. per acre. These yields are all low for this particular crop, but it must be noted that the plants suffered considerably in the seedling stage, from severe attack by grasshoppers (*Catontops* sp.) and also a brachytrupes species.

On account of the good storing qualities of this grain, (which is immune to weevil attack) it is a crop that might well be more widely cultivated by the Native, and seed has been distributed with this object in view.

Cassava (*Manihot utilissima*).—Of six North Nyasa varieties two (Chitekambwani and Kachamba) have shewn exceptional promise under plant to plant observation; acre yield comparisons will be effected this season. Every endeavour is constantly being made to popularise the growing of this excellent, hardy and high-yielding food crop, but, as in other matters, tribal conservatism in accepting a crop which the Native does not consider that of his tribe makes for slow progress.

Seed issues.—Free seed issues to Natives for the year ended have recently been made as under:—

Sorghum vulgare	...	650 lbs.	455 issues made.
Eleusine corocana	...	90 „	60 „ „
Panicum frumentaceum	...	43 „	23 „ „
Maize (imported)	...	400 „	issues not completed.

Fruit growing.—An attempt to encourage Natives to grow more fruit trees, mainly mangoes, in their villages has not met with the greatest of success, as the majority of Natives are unwilling to come in for the seedling trees which are available at Ntumbwasi, and whilst they will purchase mangoes where and when available, they seem to be unable to muster sufficient energy or interest to fence in young trees until they have grown to a size that will withstand the attack of goats feeding upon them.

During the year just ended the following seedling trees have been distributed:—*Mangifera indica* (mangoes) 1,282, *Anacardium occidentale* (Cashew) 113.

It is hoped that a greater interest will be taken in this desirable objective during the coming rains; mango, cashew and papaw seedlings are awaiting issue and there will be, I trust, a limited number of grenadilla seedlings also.

Poultry improvement.—A scheme for the improvement of the local native poultry was commenced in late April by issuing free eight young Rhode Island Red cockerels to various headmen. The half-bred progeny are a great improvement on the local fowl and a number of these have been redistributed to other villages. The scheme will be continued.

FRANK BARKER, District Agricultural Officer.

Report of the District Agricultural Officer, Chiromo.

During the year both the Chikwawa and Port Herald districts (except the hill areas) have been toured. In the Chikwawa district lectures were delivered at 31 centres where villagers from surrounding villages within easy distance were gathered: 1,953 adult men and women attended these lectures. In the Port Herald district lectures were delivered to 6,976 adults at 54 centres visited. These lectures were greatly appreciated and extraordinarily well attended in most instances; sometimes there were as many as 300 odd present, but on several occasions the attendance was very poor there being only 20 to 30 present; the usual number present was anything from 80 to 90.

Native Food Crops.—The native food position generally throughout the Lower Shire districts has been satisfactory during the past year, though on dambo areas subject to flood food crops have been more or less a failure; even the sweet potato crops have yielded very poorly this season owing to late planting. Natives on the dambo areas have, however, been able to get their food requirements without difficulty from those more favourably situated on higher ground. From the beginning of November to date, however, as is usual at this time of the year, food has been both scarce and expensive owing to waste in the months of plenty.

Natives are now showing a greater disposition to adopt the practice of planting their crops in rows. This has been done more generally in regard to cotton though, cotton being a comparatively new crop to the Natives; it has been more or less regarded by them as a "European" crop and they have been more disposed to listen to advice in regard to it, but food crops are regarded in an entirely different light.

Food crops were planted by their forefathers and Natives, being very conservative, have been loath to depart from established custom and it has in consequence been much more difficult to persuade them to improve their methods in relation to these crops, especially when it promised (to their minds) to entail additional and more difficult work. In view of this it is gratifying to notice this season that the planting of foodstuffs in rows (principally maize) is becoming more general.

It also noted that they are now reducing the amount of seed planted to less than half that which they have been in the habit of doing, but there is still room for improvement. Natives are very sceptical (and with good reasons) about reducing the amount of seed planted because of the severe insect damage suffered by crops in their early stages of growth in these districts. For this reason and the fact that Natives are accustomed to thinning out immature green stalks for food, the practice of heavy planting is not considered a serious matter as they will no doubt reduce the amount of seed still further if and when it is ascertained from practical experience that it is advisable to do so.

It was observed last season that many Natives had unfortunately adopted the practice of planting alternate rows of maize and cotton, or machiwere and cotton (no doubt with the idea of saving labour), but the folly of this practice has been fully explained to them in lectures and it is hoped that considerable improvement will result in the coming season.

Yield of native food crops.—Shortly after my arrival here an endeavour was made to secure figures bearing on the yields of various native food crops in these districts and, with this end in view, a number of gardens were measured before reaping had commenced. The acreage yields of native crops investigated this season are as under:—

	Yield per acre.
Machiwere (*Pennisetum typhoideum*)	1,450 lbs.
Maere (*Eleusine coracana*)	525 „
Chimanga—flint (*Zea mays*)	1,100 „
Mapira—Mostly "Ngonko" (*Sorghum vulgare*)... ...	560 „
Cotton (*G. hirsutum*) ... ... (Lint) ...	66 „

Native Cotton Industry.—As expected, Natives were found to have lost a good deal of their enthusiasm for this crop during the last two years, this attitude being largely due to the steady and consistent fall in cotton prices since 1925.

Cotton Seed Issued.—The amount of seed distributed at the various centres last season are shown hereunder, viz:—

Pt. Herald district.	Weight of seed issued	Tons
Konjedza	67,552 lbs. ...	30
Chimombo	33,606 ...	15
Pt. Herald	98,673 ...	44
Nachikaza	99,349 ...	44.3
Tengani	40,705 ...	18.3
Kalumbi	17,204 ...	8
Chiromo	85,405 ...	38
Kaombe	10,300 ...	4.5
Lalanji	36,810 ...	16.5
Chikwawa District.		
Mozongozo	5,720 ...	2.5
Munga	53,670 ...	24
Makwira	47,560 ...	21.25
Mitoli	17,786 ...	8
Nkadana	18,175 ...	8
Total ...	632,615 lbs.	282.5

This represents 20,209 issues (i.e. 31.3 lbs. per issue) but as there are only 12,420 gardens a number of Natives must have come back a second time for further supplies, possibly wishing to replant gardens which were destroyed by floods. The seed issued in 1924, i.e. the last year for which figures are available, was 507,920 lbs., representing 15,575 issues (or 33.5 lbs. per issue).

The seed issued is undoubtedly wasted by Natives, and the urgent necessity for great economy of seed has been carefully and fully explained to Natives in lectures throughout these districts, and it is hoped that a decided improvement will be effected without adversely affecting the quantity of cotton produced next season.

Cotton Crop, 1927.—At the end of August last the crop expected was estimated at 898 tons for the whole of the Lower Shire (both Chikwawa and Port Herald districts). This was based on an average of three quarters of an acre per garden, and an expected yield of 50 lbs. per acre, but the estimate has been exceeded by about 200 tons.

Size and yield of average native cotton gardens.—A number of native cotton gardens were measured and "yield" tickets provided. These tickets were presented to the buying officer by the owners of the gardens to have weights inserted when selling their cotton, and basing figures on these and the total crop bought (taken at 1,100 tons) the average size of a native cotton garden on the Lower Shire this past season has been found to be 1.2 acres in area and to have yielded 66 lbs. of lint per acre; this is 0.45 acre greater area per garden, and an increased yield of 0.16 lbs. lint per acre over 1924.

Cotton crop prospects, 1928.—The cotton price fluctuations have been a severe stumbling-block to Natives in the past, and it has been imperative that efforts should be made to enlighten Natives in this matter; causes of price fluctuations have therefore now been simply and carefully explained throughout these districts. It has also been impressed on them that, although it is not possible to say what prices are likely to be next season—indeed for that very reason—their only chance of success in the industry lies in planting cotton every year without exception. To make this clear, it has been pointed out that they will then have cotton to sell if and when prices do rise, whereas, on the other hand, if they plant spasmodically and only after a season of high prices, they will in all probability only have cotton for sale when prices are low, it being made apparent that, like themselves, all others interested in cotton in other countries tend to increase production when prices are high, resulting in over-production and consequent lowering of prices.

Natives now appear to have grasped these arguments and are again showing renewed interest in the industry, and a big increase in production is confidently expected next season despite the seed shortage and reduction in amount of seed to be issued to individuals.

Native Agricultural Instructors.—In September all the native agricultural instructors were called in to Chiromo for a month's course of training. In this course they were instructed and given practice in mathematics useful in the checking of cotton prices, etc.; they were also shown how to measure (step off) garden areas and given practice in adjusting their paces to the standard yard. Further, instructions and demonstration in drainage, terracing, contour planting, and other forms of soil conservation were given, besides a general course in elementary botany and soil management, also forest conservation, fruit-growing in villages, rotation of crops, cultivation, cotton prices fluctuations, cotton-grading, etc.

The interest shown by these capitaos indicates that such courses will do a great deal to stimulate more intelligent interest in their work.

N. D. Clegg, District Agricultural Officer, Chiromo.

EUROPEAN AGRICULTURE.

Name of District.	Total Acreage under cultivation. Acres.	Cotton. (Lint)		Tobacco.		Maize.		Tea.		Coffee.		Rubber.		Chillies.	
		Acres under crop.	Yield cwts.	Acres under crop.	Yield cwts.	Acres under crop.	Yield cwts.	Acres under crop.	Yield cwts.	Acres under crop.	Yield cwts.	Acres under crop.	Yield cwts.	Acres under crop.	Yield cwts.
Lower Shire	5,549	62	48	254	700	451	2,367	...	...	...	...	...	...	..	...
Chikwawa	3,712	2,327	1,499	335	904	272	1,750	...	...	...	...	...	...	...	...
Central Shire	980	..	...	811	3,114	33	280	...	...	80	12	..	...	...	...
Cholo	13,872	6	1	6,457	27,090	992	10,062	833	921	110	12	...	...	...	...
Mlanje	10,154	...	...	2,112	8,078	632	6,582	6,236	10,109	129	20	...	...	...	...
Blantyre	6,824	12	4	3,689	13,640	513	5,030	...	...	504	473	...	...	...	...
Chiradzulu	5,064	...	...	2,529	7,722	301	3,346	...	...	...	...	...	...	...	..
Zomba	6,637	118	82	4,093	14,981	722	7,151	...	...	119	35	...	...	15	4
Upper Shire	233	5	10	137	344	40	500	..	...	...	...	.	...	...	...
South Nyasa	2,088	..		1,696	6,207	87	770		...	31	2	...	...	...	...
Ncheu	2,076	15	4	1,564	6,487	242	3,220	...	...	208	19	20	8	...	...
Dedza	702	...	...	595	1,382	...	...	...	...	20	...	...	...	...	...
Fort Manning	75	...	...	39	142	...	...	..	...	...	...	...	...	...	...
Lilongwe	657	...	...	443	1,552	138	1,900	...	...	...	...	...	...	...	...
Dowa	54	...	...	..	...	7	60	...	...	...	...	...	...	...	...
Kota Kota	28	..	...	...	...	4	8	...	...	...	...	...	...	...	...
Kasungu	11	...	...	...	...	6	20	...	...	...	...	...	...	...	...
Mombera	...	...	...	...	...	...	...	...	...	..	...	...	...	...	...
West Nyasa	1,300	...	...	...	...	...	...	...	...	...	...	1,300	1,591	...	...
North Nyasa	907	...	...	248	1,304	259	3,910	1	1	38	1	...	...	...	...
Total ...	60,923	2,545	1,648	25,002	93,647	4,699	46,956	7,070	11,031	1,239	574	1,320	1,599	15	4

EUROPEAN AGRICULTURE, 1927—CONTINUED.

Name of District.	Capsicums.		Fibres.		Beans.		Groundnuts.		Wheat.		Miscellaneous.		Timber and Firewood.		English Potatoes.		Millet.	
	Acres under crop.	Yield cwts.	Acres under crop.	Yield cwts.	Acres under crop.	Yield cwts.	Acres under crop.	Yield cwts.	Acres under crop.	Yield cwts.	Acres under crop.	Yield cwts.	Eucalyptus acres.	Others acres.	Acres under crop.	Yield cwts.	Acres under crop.	Yield cwts.
Lower Shire	...	...	4,750	15,141	7	25	3	18	..	...	...	...	22	...	...	..	...	...
Chikwawa	...	...	...	...	2	2	...	...	...	...	...	...	141	5	...	...	630	760
Central Shire	...	...	..	...	...	...	...	...	...	...	...	...	29	27	...	..	...	...
Cholo	...	...	1,470	5,600	701	1,676	18	110	...	...	57	290	2,917	311	...	...	...	...
Mlanje	...	...	...	...	206	783	15	75	...	...	...	...	301	523	...	...	...	...
Blantyre	1	3	...	...	51	96	4	4	...	...	27	76	1,925	98	...	...	...	...
Chiradzulu	...	...	...	...	157	242	3	4	...	...	43	94	1,933	93	...	...	...	...
Zomba	...	...	60	...	270	1,770	6	25	1	3	278	482	690	265	...	...	...	...
Upper Shire	...	...	...	...	6	100	5	50	...	...	40	120	...	...	...	...	...	...
South Nyasa	..	...	...	...	1	6	...	...	...	...	...	...	129	144	...	...	...	...
Ncheu	...	...	...	...	13	42	1	3	...	...	1	1	5	7	...	...	...	...
Dedza	...	...	...	...	2	12	...	...	10	60	2	10	41	12	20	325	...	...
Fort Manning	...	...	...	...	12	33	...	...	24	60	...	...	...	...	...	...	...	...
Lilongwe	...	...	...	...	4	34	...	...	...	...	...	...	42	30	...	...	...	...
Dowa	...	...	...	...	3	16	...	...	12	101	2	7	15	15	...	...	...	...
Kota Kota	...	...	...	...	1	2	...	...	3	10	1	2	7	12	...	...	...	...
Kasungu	...	...	...	...	...	...	...	...	...	...	...	...	2	3	...	...	...	...
Mombera	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
West Nyasa	...	...	...	...	...	...	...	...	...	...	...	...	...	..	...	...	...	...
North Nyasa	...	...	2	2	165	1,110	2	14	141	1,350	15	114	28	4	4	60	...	...
Total	1	3	6,282	20,743	1,601	5,949	57	303	191	1,584	466	1,196	8,227	1,554	24	385	630	760

NATIVE AGRICULTURE, 1927.

District.	Seed Cotton.	Rice.	Wheat.	Ground-nuts.	Tobacco.	Maize.	Peas and Beans.
	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.
Lower Shire ...	779	—	—	—	—	—	—
Chikwawa ...	352	—	—	—	—	—	—
Central Shire ..	147	—	—	—	—	—	—
Cholo	—	—	—	—	353	—	—
Mlanje ...	25	10	—	—	364	—	—
Blantyre ...	24	—	—	—	345	—	—
Chiradzulu ...	—	—	—	—	562	—	—
Zomba ...	—	—	—	—	193	—	—
Upper Shire ...	11	—	—	—	14	—	—
South Nyasa ...	4	—	—	—	22	—	—
Ncheu ...	16	—	—	—	187	—	—
Dedza ...	21	—	—	—	86	—	—
Fort Manning ...	—	—	—	—	48	—	—
Lilongwe ...	—	—	—	—	860	—	—
Dowa	8	120	—	—	384	—	—
Kota Kota ...	—	87	—	—	66	—	—
Kasungu ..	—	—	—	—	—	—	—
Mombera ..	—	—	—	—	—	—	—
West Nyasa ...	—	23	—	—	—	—	—
North Nyasa ...	—	70	67	—	—	—	—
Total	1,387	310	67	—	3,484	—	—

NOTE.—Maize is the staple foodstuff in most districts; groundnuts, rice, wheat, beans, and various other crops are also grown by natives for local consumption, but it is impossible to make an accurate estimate of the quantities of any of these crops.

NATIVE LIVE STOCK.

District.	Cattle.	Sheep.	Goats.	Pigs.
Lower Shire	23	1,229	8,754	8,970
Chikwawa	139	137	688	1,844
Central Shire ..	419	305	2,007	760
Cholo ...	67	90	862	850
Mlanje	40	600	4,000	2,000
Blantyre	452	986	4,000	682
Chiradzulu ..	1,047	844	5,248	4,188
Zomba ..	542	1,500	5,000	200
Upper Shire ..	25	3,354	7,360	30
South Nyasa ...	951	15,225	15,527	7
Ncheu ..	7,492	5,473	29,007	13,460
Dedza ..	11,671	12,679	22,922	8,216
Fort Manning	1,109	2,841	4,049	2,267
Lilongwe ..	10,500	14,000	38,000	4,000
Dowa	14,000	25,000	25,000	6,000
Kota Kota ..	1,792	4,692	5,737	1,238
Kasungu ...	3,635	2,483	2,686	—
Mombera ...	30,000	6,000	12,000	60
West Nyasa ...	4,123	355	2,027	—
North Nyasa	28,385	900	3,000	30
Total	116,412	98,693	197,874	54,802

LIVE STOCK OWNED BY EUROPEANS.

District.	Cows and Heifers over 1 year.	Bulls.	Oxen.	Calves.	Pedigree Cattle.	Horses.	Mules.	Donkeys.	Sheep.	Goats.	Pigs.
Lower Shire	765	19	495	430	1	...	...	1	55	20	50
Chikwawa	491	8	534	158	.	..	...	7	...	...	34
Central Shire	43	3	50	24	.	..	...	3	5	...	13
Cholo	1,286	49	1,534	611	4	2	3	25	368	33	181
Mlanje	1,153	29	1,197	460	2	5		8	251	181	19
Blantyre	1,301	31	1,129	589	9	1	1	30	43	82	50
Chiradzulu	808	16	678	371	9	.	.	27	55	34	27
Zomba	1,382	23	1,747	652	36	1	2	41	275	50	91
Upper Shire	4	..	1	4	..	..	...	.	37	41	27
South Nyasa	108	11	95	59	.		...	2	128	109	...
Ncheu	380	10	272	158	2	.	..	8	25	22	220
Dedza	522	26	401	310	..	.	2	81	104	10	90
Fort Manning	165	3	193	35	..	...	...	12	35	...	26
Lilongwe	178	4	109	111	1	.		15	15	10	48
Dowa	66	2	51	27	...	..	...	10	50	30	46
Kota Kota	35	4	27	16	...	.	...	5	30	6	13
Kasungu	.	..	...	2	...	...	...	...	2	6	...
Mombera	14	2	7	9	...	...	...	3	...	...	1
West Nyasa	10		1	7	..	...	..	...	...	...	...
North Nyasa	141	24	224	64		..	..	8	64	...	95
Total	8,852	264	8,745	4,097	64	9	8	286	1,542	634	1,031